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A Revision of Couma and Parahancornia (Apocynaceae)[1]

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INTRODUCTION

Conspectus.—In this article Couma and Parahancornia are revaluated. *Couma oblonga* and *C. amara* are transferred to Parahancornia. Four names are placed in synonymy under *Couma macrocarpa*, and three new species are described in Parahancornia. An attempt is made to summarize the more important taxonomic information concerning these genera and their species, whereas all outstanding non-taxonomic references are at least included in the bibliography. Nevertheless, the following contribution must be regarded as a preliminary study.

Literature.—The present article is the only integral work on the taxonomy of the Couma-Parahancornia group of plants. Schumann (57) gives incidental differential characters for *Couma guianensis*, *C. macrocarpa*, *C. utilis*, *C. rigida*, and *Parahancornia oblonga*. Mueller (41) treats only of *C. utilis* and *C. rigida*, and mentions *C. guianensis;* Barbosa Rodrigues (3) also alludes to these species of Couma in a discussion under his original description of *C. macrocarpa*. Ducke (16, pp. 242–243) gives interesting field notes on *Parahancornia amapa*, *Couma utilis*, *C. guianensis*, and *C. macrocarpa*. The remaining works generally treat merely of single species, often not allotting them more than a passing allusion. Of the non-taxonomic articles on Couma or Parahancornia that deserve special notice, mention should be made of Karling's "Couma guatemalensis as a possible future source of chicle"; Rouelle (54) and Rothge (53) give an analysis of the resin or latex, while Record (49 & 50), Williams (66 & 67), and Benoist (6) treat of the wood anatomy of certain species.

Abbreviations of herbaria and acknowledgments.—In order to conserve space, no place of deposit is indicated when a particular collection is represented either in the Britton Herbarium or in the Krukoff Herbarium at the New York Botanical Garden, except when it is a type collection. Otherwise

[1] This contribution is made possible only by the co-operation of Mr. B. A. Krukoff, whose field assistants collected the bulk of the important material examined by me and whose guidance and criticism fashioned the following treatise in its present form.

the depository is thus abbreviated: A—Arnold Arboretum, Jamaica Plain; F—Field Museum of Natural History, Chicago; G—Gray Herbarium, Cambridge; M—Missouri Botanical Garden, St. Louis; Mich—University of Michigan, Ann Arbor; NY—New York Botanical Garden, New York; Y—Yale School of Forestry, New Haven. Acknowledgment is here made to the directors and curators of the institutions listed for their generous loans of herbarium material, and my particular gratitude is expressed for the aid rendered to me by Mr. E. J. Alexander and Drs. Bassett Maguire, H. A. Gleason and H. N. Moldenke.

SYSTEMATIC TREATMENT

COUMA and PARAHANCORNIA: tribe CARISSEAE (7, p. 684. 41, p. 6) or PLUMIEROIDEAE-ARDUINEAE (57, p. 122); unarmed trees with non-poisonous latex, the trunk columnar, not buttressed or deeply channelled; leaf-blades rounded to abruptly acuminate and bluntish at apex, the veins impressed on upper side, the secondaries moderately spaced; inflorescence dichasial; pedicels short or none; flowers usually in triads; calyx 5- or 4-parted, the lobes essentially equal, less than 4 mm. long, without glands or squamellae, more or less pubescent to merely ciliate, mostly bluntish at apex; corolla less than 2 cm. long, slightly swollen at region of insertion of anthers, pubescent to glabrous outside, pubescent within at least at throat of corolla-tube and near point of insertion of anthers, the corolla-lobes 5, about as long as corolla-tube, sinistrorsely contorted (viewed externally); filaments shorter than anthers, linear, inserted at about middle of corolla-tube, the anthers lanceolate, without an enlarged connective, rounded or mucronate at apex but without conspicuous extension, and without extensions at base, glabrous; ovary syncarpous, the placentas two, each on cross section the shape of a T with numerous ovules at the ends and parietal-facing sides of the expansion or cross-arm (but none on the center-facing sides or on the stalk) and with these intruded expansions often practically touching at their non-ovulate sides near center of ovary, giving it a 2-celled axile-placental appearance, or here actually connected (particularly in Parahancornia) making the ovary 2-celled,[2] the style entire, usually longer than ovary at maturity (sometimes shorter in Parahancornia), swollen at apex, the stigma two-cleft, minutely hispidulous or glabrous; fruit a (mostly edible) berry with several to many seeds.

Leaves whorled, ternate or quaternate on trigonous or squarish branchlets, the *petioles with a thick broad saucer-like axillary gland,* the blades with secondaries usually of about equal prominence and arcuate near leaf-margins, the undersides sometimes with scattered black dots of unequal sizes; *inflorescences axillary* and quickly becoming obviously so by growth of terminal shoot; *calyx-lobes*

[2] The general form of placentation is excellently illustrated in the photomicrograph of a transverse section of *Lacmellia edulis* Karst., pl. 5, fig. 2, Bull. Torr. Bot. Club **65** (3). 1938. Robert E. Woodson Jr. and John Adam Moore, The vascular anatomy and comparative morphology of apocynaceous flowers.

usually 5, pubescent inside (at least near margins) with adpressed hairs; anthers inserted near middle or somewhat above middle of corolla-tube; *ovary more or less imbedded in receptacle (inferior) and capped with carnose tissue* at the deeply depressed and furrowed, truncate or slighty elevated apex, *always glabrous*, the stigma oblong to linear-lanceolate from a subcylindrical podium which is sometimes fringed at base with an obscure shallow membrane, the *stigma-lobes hispidulous* (except in *C. macrocarpa*).....*Couma.*
Leaves opposite on flattened or subterete branchlets, the *petioles without glands*, the underside of blades with secondaries usually of varying prominence and deliquescing near leaf-margins, not dotted; *inflorescences terminal* (and axillary); *calyx-lobes usually 4*, broadly ovate, about 1 mm. long and about as broad, rounded at apex, *glabrous inside;* anthers inserted mostly somewhat below middle of corolla-tube; *ovary mostly superior and not capped with thickened tissue* at the rounded to conical (or flattened) apex, *always closely pubescent* with adpressed, ascending or erect, short hairs, the stigmas lanceolate from a usually pyriform podium lacking a membranceous collar, the *stigma-lobes glabrous*.....*Parahancornia.*

COUMA Aubl., Pl. Guian. **2** (Suppl.): 39. 1775.
Collophora Mart., Buchn. Repert. Pharm. **35**: 186. 1830.
Cuma O. Kuntze & Tom von Post, Lex. Gen. Phanerogam. 152. 1904.

Type species.—*Couma guianensis* Aubl.

Couma is found only in the tropics of the Western Hemisphere. *C. macrocarpa* has been collected in the Atlantic lowlands of Guatemala and British Honduras. This species is then found again in Panama, and from thence on is somewhat common in gregarious or scattered stands in British Guiana, Venezuela, and the Amazonian region of Colombia, Peru, probably Bolivia,[3] and throughout Amazonas in Brazil. Its range half encircles that of *C. utilis* and mingles with it in Amazonas; on the Rio Negro *C. utilis* becomes the more common species, and on caatingas of the upper Rio Negro is found *C. catingae*. In Para in Brazil, and in the Guianas, *C. guianensis* is the dominant Couma. Correa reports Couma from Maranhao and Travares (64, p. 168) states that *C. rigida* is found from Bahia to Amazonas. But recent field investigations carried on under directions of Mr. Krukoff seem to set *C. rigida* off in Bahia (see discussion on Tate 732 under *C. rigida*) with no species of Couma forthcoming from the intervening territory.

The ovary of Couma at anthesis is frequently inferior (a carnose superimposed cap gives the appearance of a superior ovary), so that a cross section through its ovulate portion entails dissection below the calyx;[4] however, it quickly raises itself from this primordial condition and the fruit is obviously superior with the calyx usually persistent at the base. A. de Candolle and Lindley place Couma in the tribe Willughbeiae with a 1-locular ovary, in contradistinction to Carisseae with a 2-locular ovary. The number of cells in the ovaries of Couma and Parahancornia is not an im-

[3] The small amounts of chicle that are being shipped from Bolivia (65, p. 3) are probably derived from this species of Couma.

[4] The immersed character of the ovary in Couma is not unique in the family. The photomicrograph of a longitudinal section of the ovary of *Plumeria rubra* L. shown in pl. 5, fig. 5, of Woodson & Moor's article (previously cited in footnote) is a good illustration of the type of inferior ovary which is found in Couma.

portant character, as the placentation is essentially the same in both genera. Miers (39, p. 18) writes: "I have stated that this genus [Ceratites] approaches Couma in structure: the latter is described and figured by Muller, who alleges that it has no disk; but I have found in C. dulcis and C. oblongifolia a decided disk, concealing 2 pilose ovaries as in Ceratites." *C. dulcis* is *Couma utilis* and its ovary is glabrous as in all Couma species. *C. oblonga* ("oblongifolia") is here transferred to Parahancornia. In no case have I seen in either genus a distinct hypogenous disk. The nearest relative of Couma is Parahancornia.

The species of Couma, as defined in the present treatment, are closely interrelated. *C. macrocarpa* is the most distinctive, with its non-hispidulous, very short, blunt stigma-lobes unlike those of the remaining species. Typical *C. guianensis* has the field aspect of *C. macrocarpa* in its habit of flowering before foliation, in its expansive many-flowered inflorescences and in its large leaves borne on thick branchlets; herbarium material of this species (particularly from Para), however, sometimes grades into *C. utilis*. *C. catingae* with its quaternate, long-petioled large leaves conspicuously dotted with minute dark specks on the undersides, and its white, externally glabrous, small flowers on elongated peduncles, is very striking; it is difficult to judge whether it is closer to *C. utilis* or *C. rigida*. *C. rigida* and *C. utilis* are apparently Bahia-Amazonas counterparts, regional-topographical direct offshoots of a single prototype. *C. rigida* is best distinguished from *C. utilis* by its coriaceous large leaves densely dotted on the undersides and sessile on thick brachlets, more congested inflorescences, and flowers with longer stigmas.

The members of this genus are trees, approximately 30 to 150 ft. tall and 1 to 2 ft. in diameter; the bole straight and generally free of branches for more than half its height, the bark almost smooth or coarsely granular, red-brown or chocolate-brown to ashy, up to about ½ in. thick, fairly brittle and splitting longitudinally and transversely; the fruits are about 1 to 2 inch. in diam., generally light yellow or green.

Their local names do not clearly distinguish the different species in regions where the distributions overlap, consequently from a practical standpoint the vernacular names, being largely a result of geography rather than botanical acumen, merely indicate the localities where representatives of the genus are found and little more. Fortunately, only *C. macrocarpa* and *C. utilis*, usually called Sorva Grande and Sorveira or Sorva Pequena, respectively, present a serious geographical-habitat intermixture in distribution (in the Amazon). This difficulty is also encountered with *C. guianensis* in western Para. In the following list of representative local names obvious variant spellings and topographical, regional and descriptive adjectives (e.g., Kuma-uacu, Couma da Catinga, Sorva de Belem, Sorva Folha Miuda) are omitted. Brazil, states of Amazonas & Para:

Cuma-assu, Couma-i, Couman, Sorva, Sorveira, Sorvinha; state of Bahia: Macuge. French Guiana: Couma, Poirier. Dutch Guiana: Amapa, Amaparian, Alkoema, Apalan, Bauka-mapa, Djakali, Dokalli, Pera. British Guiana: Dukaballi, Dukalliballi, Dukataballi, Karimein. Venezuela: Arbol de Vaca, Vacahosca, Cajiman, Capiron, Guaimaro Macho. Colombia:[5] Arbol de Leche (the species with this vernacular name is listed as "Apocinea indeterminada" in Bravas' article), Juansoco, Perillo. Peru: Fransoca (the latex), Leche Caspi, Osurba. Panama: Perillo Tree. Guatemala: Palo de Vaca (Cow Tree). British Honduras: Barca, Palacio.

The principal use of Couma is found in its latex which is used as a basic material in the manufacture of chewing gum (particularly that of *C. macrocarpa*, which is, at least in part, the source of Perillo gum). The latex is generally palatable (drunk directly or mixed in coffee or used in "mingaos"); it is sometimes used (with the seeds) as a vermifuge, as well as a cement or caulk, varnish and cautchouc. The wood of *C. guianensis* is reported used for ship masts, and that of *C. utilis* and *C. macrocarpa* for general carpentry. The fruits of all the species are palatable; they are served in desserts and used to make a cooling drink; they are said to be eagerly sought by animals and birds.

DESCRIPTION AND KEY TO THE SPECIES OF COUMA

(Key-characters printed in italic)

A. Branchlets thick, *densely puberulent* to glabrous; petioles about 1.5 cm. long, *minutely puberulent;* blades large, up to 38 cm. long and 20 cm. broad, *broadly ovate, length to width approx. 3:2, cordate,* truncate or obtuse at base (rarely acutish), abruptly short-acuminate at apex (the acumen up to 4 cm. long), the nerves on underside usually more or less *puberulent* with minute spreading hairs, the secondaries about 20 pairs, the *reticulation fine* and uniform; inflorescences expanding before foliation, spreading and broad, with numerous rose colored flowers; calyx-lobes oblongish-ovate to oblongish-lanceolate; flowers sparsely to moderately pubescent outside, the corolla-tube densely pilose within near middle and at throat but with a glabrous space in between; ovary deeply depressed at apex and strongly furrowed, the stigma-lobes comparatively *very short* (less than 0.5 mm. long), blunt and *glabrous* under a hand-lens (microscopically papillose) ..... 1. *C. macrocarpa.*

A. Petioles essentially glabrous; blades generally *elliptic,* usually *twice or more longer than broad, narrowed at base* and cuneate, *glabrous* (the undersides sometimes very sparsely puberulent on nerves and rarely barbate in axils with lax rusty hairs), the secondaries mostly less than 18 pairs, the reticulation not fine and uniform; calyx-lobes mostly ovate to ovate-lanceolate; flowers with stigma-lobes *elongated* (over 0.5 mm. long) and mostly acutish, *hirsutulous* with ascending or spreading hairs ..... B.

B. Branchlets thick; petioles 0.5–1.5 cm. long; blades 9.5–25 cm. long and 4.5–11 cm. broad, the secondaries 13–15 pairs; inflorescences expanding *before foliation, spreading and broad,* with *numerous* rose colored flowers; pedicels and calyces densely puberulent, the calyx-lobes ovate to oblong-laneolate; typical corolla cinereous puberulent outside, the corolla-tube pilose within near middle and at throat but with *glabrous space in between* ..... 2. *C. guianensis.*

[5] Cortes gives the name "Avichuri" for a species of Couma in San Martin, Colombia. Apolinar Maria writes: "El verdadero arbol de leche es Brosimum utile, que llaman 'avichuri' en los llanos de San Martin." (Vocabulario de terminos vulgares en historia natural colombiana. Rev. Colomb. Cienc. Exactas, Fise. y Nat. **3**: 80. 1939). "Lirio" appearing in Vander Laan's article is probably an error for Perillo.

B. Inflorescences expanding *after foliation*, moderately spreading to congested and comparatively few flowered; corolla glabrous to densely puberulent, the corolla-tube pilose within continuously from near middle to throat and *with no glabrous space in between* (except *Riedel s.n.*)..C.

C. Leaves usually *quaternate* on thick quadrangular branchlets; *petiols 2.5–3.5 cm. long;* blades variable in shape, generally elliptic, 7–35 cm. long and 4–17.5 cm. broad, *conspicuously dotted* on underside; inflorescences crowded, few to moderately flowered, the *peduncles elongated*, 8–13 cm. long; calyx-lobes broadly ovate and rounded at apex; flowers small (10–12 mm. long), *white*, the corolla-tube *glabrous* outside, the corolla-lobes sparsely puberulent..3. *C. catingae.*

C. Leaves *ternate* on triangular branchlets; petioles usually *less than 1 cm.* long; blades mostly less than 16 cm. long and 7 cm. broad; peduncles usually *less than 5 cm.* long; calyx-lobes ovate to oblong-lanceolate; flowers *rose colored*, the corolla-tube *puberulent* outside.....D.

D. Branchlets *slender; petioles 0.2–1 cm. long; blades mostly 5–12 cm. long and 3–5 cm. broad, not dotted* on underside, the tertiaries usually obvious; inflorescences moderately crowded; flowers with *stigma-lobes about 0.5 mm. long.* (Amazonas).....4. *C. utilis.*

D. Branchlets *thick;* leaves *sessile*, the blade *greatly attenuate* at base and broadly decurrent on petiole, *usually 13–16 cm. long and 5.5–7 cm. broad*, coriaceous with margins strongly revolute, the underside *conspicuously black-dotted*, the tertiaries obscure; inflorescences congested; flowers with *stigma-lobes about 1 mm.* long. (Bahia).....5. *C. rigida.*

1. COUMA MACROCARPA Bar. Rodr., Vellosia, ed. 2, **1**: 32. Pl. 1, fig. B. 1891.

C. sapida Pittier, Bol. Com. e Ind. **4**: 84. 1923.—nomen nudum. Bol. Cient. y Tecn. Mus. Com. Venez. **1**: 69. 1925.

C. guatemalensis Standl., Trop. Woods **7**: 8. 1926.

C. Capiron Pittier, Bol. Soc. Venez. Cienc. Nat. **5**: 312. 1939.

C. caurensis Pittier, loc. cit., p. 313.

Type specimen.—"Rio Negro, in silvis Taruna-uacu. Barb. Rod. 460, Herb. Mus. Bot. Amaz."

Illustrations.—Type (3); a leafy branch, a vertical section of a fruit, and seeds—natural size. *C. guatemalensis* (25); photo of the trunk of a medium sized specimen showing the ibidem method of tapping. An eastern Guatemalian tree (49); photo of a trunk. *Couma caurensis* (66); photo of a trunk.

Distribution.—Atlantic lowlands of Guatemala and the extreme southern section of British Honduras; common in pastures at sea level near Puerto Barrios and frequent in wet forest, alt. about 18 m., near Entre Rios.[6] British Guiana, states of Zulia and Bolivar in Venezuela, Amazonian Colombia and Peru, and throughout Amazonas and western Para in Brazil; rather frequent on terra firma, low or high land, up to 200 m. alt.

Specimens examined.—Brazil, state of Amazonas: T. Aznar 12595/901, 12596/902, 12597/905; Ducke 29 (Sept., fls.), 122 (fls.; A, Y); Froes 100, 328, 330, 389, 394, 409, 506, 827, 838, 853, 854; Froes & C. W. Smith 10; Krukoff 1281, 5817a, 7199, 8774; C. W. Smith 603, 12214, 12223. Brazil, state of Para: C. W. Smith 12521 (Rio Tapajos, Sao Luiz). British Guiana, basin of Essequibo Rv.: A. C. Smith 2579 (Kuyuwini Rv.), 2713 (Near mouth of Onero Creek). Venezuela: Adams 26 (Amazonas, Guaruti); Pittier 10976 (Zulia; type coll. *C. oapida;* G, NY); L. Williams 11530 (Bolivar), 12009 (Bolivar; type coll. *C. caurensis;* F, NY). Colombia: R. W. Crosse 12287, 12579; Cuatrecasas 7253 (Vaupes; Oct., fls.). Peru, dept. of Loreto: L. Williams 912 (upper Nanay; M), 2100 (Caballo-cocha; M); Tessmann 4155 (mouth of Rio Santiago; fls.). Panama: Salas 12500. Guatemala, dept. Izabal: Krukoff Herb. 12392; Kuylen 69 (Yale Ser. No. 9711); Record 42 (Yale Ser. No. 8873; type coll. *C. guatemalensis;* March, fls.; NY, Y); Standley 72623 & 73060 & 73157 (F). British Honduras, Toledo district: Hope 17 (Temash Rv., broken ridge bush; Apr., fls.; F, M, Y).

[6] For a description of the habitat in Entre Rios, Guatemala, see Karling (25, pp. 580–581).

The type of *C. guatemalensis* (deposited in the U. S. National Herbarium, No. 1209923), collected in the valley of the lower Rio Motagua, near Entre Rios, in Guatemala, on March 1, 1926, by S. J. Record (No. 42; Yale No. 8873), consists of flowering material and immature leaves. I have seen the type collection, and also Kuylen 69, collected at Entre Rios, Oct. 1926, with mature leaves. The stigmas of both the type coll. and Hope 17 are slightly longer and sharper than those of the Amazonian specimens of *C. macrocarpa* examined thus far (up to about twice the length of those of Ducke 29).

The type of *C. sapida*, Pittier 10976, collected in "Selvas del rio Lora cuenca del rio Santa Ana (Distritos Perija y Colon), Zulia; Dec. 1922," consists of branchlets with mature leaves and "una fruta recogida en el suelo y casi podrida." Dr. Pittier states that his Venezuelan plant differs from *C. macrocarpa* in the "pilosiusculus" costa and nerves of the blades beneath ("hojas parecen siempre glabris" in *C. macrocarpa*). I have seen the leaves of the type collection which I find to be a good match for some Brazilian material of *C. macrocarpa*, such as Krukoff 1281. Froes 506, from San Gabriel, is the most hairy form I have seen, with the branchlets, petioles and undersides of leaf-blades velvety pubescent.

The type of *C. Capiron*, collected in the "valle del Caura" and sent to H. Pittier by Dr. Soltero in Dec. 1932, consists of foliar material (with immature fruit). The type of *C. caurensis*, L. Williams 12009, collected in "Guayana: el Tigre, Bajo Caura, Estado Bolivar, 120 m; en la selva alta no anegada; Mayo 1939," consists also of non-flowering material (fruits mature). Pittier notes that this plant differs from *C. Capiron* in the "forma y consistencia de las hojas, attenuadas hacia la basa en lugar de truncas o emarginadas, y distintamente acuminadas," and adds "con todo, puede suceder que las dos especies propuestas se reduzean a una sola, cuando se hayan consequido materiales mas completos." *C. Capiron* is known to me only from description; *C. caurensis*, from the type collection.

C. macrocarpa consists of many different forms which, however, intergrade in a way that makes it not feasible to recognize them as segregates in the present preliminary study. The leaves vary from 8 to 30 cm. in length and 6 to 19 cm. in width, the leaf-bases are usually subcordate or truncate, but sometimes merely rounded or, rarely, narrowed, the undersides usually glaucescent, but sometimes without this pallor. The pubescence is strikingly variable in density, infrequently totally lacking on the leaf-blades (present only on the petioles).

2. COUMA GUIANENSIS Aubl., Pl. Guian. **2** (Suppl.): 39. Pl. 392. 1775.
Cerebera triphylla Rudge, Pl. Guian. Rar. 1: 31. Pl. 48. 1805.

Type locality.—"Sylvis Caiennae & Guianae."

Illustrations.—Type (1); leafy branches with fruits. *Cerebera triphylla*

(55); branches with leaves, flowers and a fruit, and flower analysis. Plate 56 (6); transverse and tangential sections of the wood enlarged 30 diameters.

Distribution.[7]—Savannas of Dutch Guiana, and very common in French Guiana; frequent (as a perhaps somewhat different form) in southeastern Para in Brazil. Reported from British Guiana by Schomburgk.

Specimens examined.—French Guiana: Melinon s.n. (Charoni; F, G). Dutch Guiana: Forest Bureau 2602 (Sectie O), 3824 (Sectie O; Jan., fls.); R. H. G. McArthur s.n. (Paramaribo; fls.; Y).

The type of *Cerebera triphylla* was collected in French Guiana.[8] After examining its original description and illustration I find myself in complete accordance with A. Richard, who, in placing this species in synonymy under *C. guianensis*, writes (51, p. 55) "il est impossible de meconnaitre leur indentite, soit d'apres la figure, soit d'apres la description donnée par Aublet et par M. Rudge."

In the southeastern section of the state of Para, Brazil a Couma somewhat intermediate in characters between typical *C. guianensis*[9] and *C. utilis* is fairly abundant. Its flowers often no more densely puberulent than in *C. utilis* are not cinereous. Some small leaved, slender twigged herbarium specimens of this form are indistinguishable from authenticated *C. utilis*. More field studies are necessary to ascertain whether this entity in Para is significantly different from the *C. guianensis* found in the Guianas and worthy of varietal segregation. The collections from the state of Para, Brazil, examined by me, are as follows: Dahlgren & Sella 529 & 616 (Belem; March-May, fls., F); Huber 9337 (Belem, hort. bot.; June, fls.; A, F); C. W. Smith 12506 (Rio Acangata, trib. of Rio Camaraipy), 12509 (Rio Jacarepuru), 12615 (Rio Pracupy, trib. of Rio Anapu), 12520 (upper Rio Anapu), 12582 (Rio Xingu).

3. COUMA CATINGAE Ducke, Arch. Inst. Biol. Veget. Rio Janeiro 4 (1): 59. 1938.

Cotype specimens.—"silvulis 'catinga' Rio Negro superioris, prope Cucuhy, Ducke (H. J. B. R.) 34693; prope Camanaos, fructibus novellis, Ducke (H. J. B. R.) 22407."

[7] Cortes reports it "en la region del Orinoco, San Martin"; but this distribution is not supported by any other evidence.

[8] The species described in Rudge's Plantarum Guiane Rariorum were found on the French ship "L'Union" captured by the British in 1803; no place of collection of the various plants described is given by Rudge, except for *Solena gracilis*, which on page 27 is reported from Kaw (French Guiana). The type locality for *Cordia paniculata* Rudge is given as Cayenne by I. M. Johnston (Jour. Arn. Arb. **16** (1): 27. 1935), who examined the species of Cordia in the British Museum. That all the species described in Pl. Guian. Rar. were collected in French Guiana by Joseph Martin appears from the line of evidence presented on pages 166, 87, 161 and 89 of The History of the Collections Contained in the Natural History Departments of the British Museum 1. 1904.

[9] The specific name of *C. guianensis* is sometimes spelled "guyanensis."

Distribution.—Only on caatinga of the upper Rio Negro; gregarious and abundant in the region of Rio Xie and Rio Marie.

Specimens examined.—Brazil, state of Amazonas, upper Rio Negro, municip. Sao Gabriel: Ducke 34693 (cotype coll.; Sept., fls.; NY); Froes 415 & 424 & 428 (Yuco on Rio Xie), 470 & 472 & 474 & 476 & 489 (Acara on Rio Cubate), 500 & 504 (Corocoro on Rio Vaupes), 537 (Macubeta on Rio Marie), 801 & 806 & 810 (Lago January in the basin of Rio Uenuichy), 843 & 844 (Floresta on Rio Tikie), 848 (Bussehe Cussy on Rio Castanha), 884 (Bela Vista on Rio Vaupes).

Froes 428 includes a seedling approximately 10 cm. long; apex of stem puberulent; leaves opposite, the petioles 0.6–1 cm. long, puberulent, the blades about 4 cm. long and 2 cm. broad, short acuminate at apex and cuneate at base, brown-dotted on underside, the secondaries about 10 pairs.

4. COUMA UTILIS (Mart.) Muell. Arg., Mart. Fl. Bras **6** (1): 19. Pl. 5. 1860.

Collophora utilis Mart., Buch. Repert. Pharm. **35**: 186. 1830.
Couma dulcis R. Spruce, Mass. Pl. Bras. n. 998, ex Muell. Arg., loc. cit.

Citations by Muell. Arg.—"in prov. Rio Negro silvis Japurensibus: M., et prope Barra ad margines silvarum, in silvis caeduis et in campestribus: M., Riedel 1464, R. Spruce; nec non in arenosis prope Borba ad fluv. Madeira: Riedel 1372."

Illustrations.—Probable type coll. ("e Martii Pl. Med. et Oecon. ined. desumta"; 41); flowering branchlets in leaf, and analysis of flowers and fruits. Plate facing p. 470 (11); a full page illustration of a flowering branch (copied from Mart. Fl. Bras.).

Distribution.—Amazonas of Brazil and Venezuela, scattered or gregarious, abundant in the basin of Rio Negro; the specimens from Rio Madeira and lower Rio Negro are generally from terra firma, whereas those from upper Rio Negro from restinga.

Specimens examined.—Brazil, state of Amazonas: Ducke 188 (May, fls.); Froes 324, 325, 327, 327a, 331, 342, 350, 351, 359, 401, 413, 460, 520, 531, 814, 815, 816, 12007; Killip & A. C. Smith 30005; Krukoff 5817, 7010; C. W. Smith 12222; Spruce 998 (type coll. *C. dulcis;* fls.; NY, G). Venezuela, terr. of Amazonas, Rio Ventuario, Guaruti: Adams 21, 27, 35, 42, 45; undesignated collector (Krukoff Herb.) 12621, 12622.

Although the original description of *Collophora utilis* is not sufficient to identify it conclusively with *Couma utilis,* the validity of placing it in synonymy by reason of circumstantial evidence is beyond doubt: Collophora is described from the Rio Negro (*C. utilis* is here common throughout) where it is reported to be called "Sorveira" and it is stated that its latex is used as a cement; furthermore, Mueller, who first reduced Collophora, probably examined Martius' material, and the illustration in Mart. Fl. Bras. is probably that of the type collection.

Couma dulcis was collected in the vicinity of Manaos (Barra), and it is likely the species reported frequent there by Spruce (59). I have examined the type coll. and find it to be typical *C. utilis.*

Couma utilis is variable in leaf characters and different forms are perhaps represented, but there is less support for recognizing segregates here than in *C. macrocarpa*. Froes 359, consisting of two foliar branchlets, is a good example demonstrating leaf variation in the species; the one sheet includes leaves which are linear-lanceolate, 6 cm. long and 1.2 cm. broad, typical ones that are 8 cm. long and 4.5 cm. broad, and large leaves, up to 14 cm. long and 7.2 cm. broad.

Riedel s.n.[10] from Brazil (ex Herb. Horti Petropolitani; labeled *Couma utilis;* G): This specimen differs markedly from material of both typical *C. utilis* and *C. rigida*, and from all other species of Couma examined. Branchlets thick and sharply angled; leaves sessile or subsessile, up to 13 cm. long and 7 cm. broad, rounded at apex and narrowed at base, not dotted on underside, the secondaries up to 23 pairs, 4–7 mm. apart near middle of blade; inflorescences sparsely flowered (fls. 30–40) and contracted, the pedicels glabrous, the calyx-lobes 4 or 5, broadly ovate, very short, rounded at apex, ciliate, glabrous outside, puberulent with adpressed hairs inside especially near margins; corolla sparsely pubescent outside, the corolla-tube pubescent inside at region of anthers and at throat but glabrous in between; ovary as in *C. utilis* and the stigma longer (as in *C. guianensis*). It is not formally proposed as a new species because the material is poor and not backed at present by additional collections with definite collection data.

5. COUMA RIGIDA Muell. Arg., Mart. Fl. Bras. **6** (1): 20. 1860.

C. mocuge J. Caminhoa, Element. Bot. Geral e Descrip. 1318. 1877. (Fide J. S. Travares, Broteria **15**: 166. 1917.)

Type specimen.—The original description cites the type locality and collector for this species: "silvis ad S. Domingo prov. Paraensis: Riedel absque numero." F. Rodriques da Silveira (52, p. 215) gives a very convincing argument favoring the view that the true type locality for *C. rigida* is Bahia, adducing as evidence the fact that a Couma answering closely to *C. rigida* is a typically regional plant in Bahia, where it is known as "Mucuge," while this common name is unknown in Para; furthermore, Riedel did a great deal of collecting at Bahia and little at Para; and Dr. Ducke claims never to have seen in the Amazon any plant resembling the Mucuge. Barbosa Rodriques (3, p. 33), like Ducke (15), also subscribes to this opinion, as is apparent in his discussion of Mueller's transfer of *Collophora utilis* to Couma, "descrevendo outra oriunda da Bahia, o Mokuge com o nome de C. rigida." Recent field investigations carried out in Para under the direction of Mr. Krukoff support Silveira's argument and Dr. Ducke's claim of the absence of *C. rigida* in this area.

[10] This collection is to be distinguished from another Riedel s.n. which is probably the type coll. of *Couma rigida*.

Illustrations.—Mucuge (52); plate 27, a flowering branch in leaf (nat. size) and an analysis of the flowers; plate 28, a fruiting branch in leaf and a cross section of a fruit. *Couma mocuge* (64); a photo of the fruits, and a fruit cut to show several seeds.

Distribution.—The central forested portion of Bahia and in the coastal region for some 10 miles inland in Itabuna, mostly gregarious, usually along creeks that flow from mountains, sometimes found up to over 1190 m. above sea level growing on practically bare rocks on steep slopes. *C. rigida*, or material closely resembling this species, is represented from Mt. Duida, Venezuela.

Specimens examined.—Brazil, state of Bahia: Rio Una, municip. Mucuge, Brejao: Froes 1001–1004 (Oct., fls. & frs.); Rio Paraguassu, municip. Mucuge, Ibyguara, Serra Sincora: Froes 1011–1013; municip. Andarahy: Froes 1021 (Oct., fls.), 1022 (Morro do Mocoro; Oct., fls.), 1027 (Encrusilhada); Rio Sta. Ana, municip. Itabuna: Froes 1081 (Bom Gosto); Riedel s.n. (ex Herb. Horti Petropolitani: labeled *Couma rigida;* probably type coll.; G), s.n. (photo of type). Venezuela, Mt. Duida: Tate 732 (see remarks below).

Caminhoa's *Couma mocuge*, as discussed in Broteria, answers the description of *C. rigida*. *C. mucuge* is identified as *C. rigida* by Silveira, and its illustrations are excellent matches for Froes' Bahia collection, the Riedel specimen which is probably a type coll. of *C. rigida*, and a photo of the type.

Tate 732[11] was collected on the "summit of Mount Duida, Venezuela, alt. 4400 ft., dry slopes of Savanna Hills" (Tyler-Duida expedition, Aug. 1928–Apr. 1929). It has apparently an anomalous distribution, but the plant closely resembles *C. rigida*, hardly differing from it in any important detail; leaves 8–11 cm. long and 4–6 cm. broad, rounded at apex, the secondaries 11–14 pairs instead of 16–20 as in the Bahia material. The plant may conceivably represent a new species (certainly the extreme endemism found on the sunmit of Mt. Duida would suggest this), but until better material evidence is available it had best remain under *C. rigida*.

C. rigida is the earliest Couma to have come under the notice of a naturalist. Gabriel Soares de Sousa, in his Tratado Descriptivo do Brasil em 1587, writes: "Macuge e uma arvore comprida, delgada e muito quebradica, e da-se em areas junto dos rios, perto do salgado, a pela terra dentro dez ou doze leguas. Quando cortam esta arvore, lanca de si um leite muito alvo e pegajoso, que lhe corre em frio; a qual da umas frutas do mesmo name, redondas, com os pes compridos e cor verdoenga, e sao tamanhas com macas pequenas; e quando sao verdes travam muito, e sao todas cheias de leite. Colhem-se inchadas para amadurecerem em casa, e como sao maduras tomam a cor almecegada; comem-se todas como figos, cujo sabor e mui suave, e tal que lhe nao ganha nenhuma fruta de Hespanha, nem de outra menhuma parte; e tem muito bom cheiro."

[11] For a description of the habitat and for the plant associates of this collection see Bull. Torr. Bot. Club **58** (5): 297–298. 1931.

SPECIES EXCLUDED FROM COUMA

COUMA FASCICULATA R. Ben., Arch. Bot. **5** (mem. 1): 253. 1931. Benoist place *Tabernaemontana fasciculata* Poir. and *Parahancornia amapa* Ducke in synonymy under this name. *Tabernaemontana fasciculata* is not known to me; its original description, however, seems not to fit either Couma or Parahancornia. Benoist explicitly characterizes Couma as having a berry for a fruit, thus implying that his species was in possession of one. It is then a question as to whether *Couma fasciculata* is not truly *Parahancornia amapa*. Benoist states "Le Couma fasciculata R. Ben. se recontre ca et la en Guyane."

COUMA PENTAPHYLLA Huber, ex Ducke Bol. Mus. Goeldi **7**: 124. 1913.—nomen nudum. (First published in Estado do Para, Dec. 1911.—fide footnote, Bol. Mus. Goeldi **7**: 100.) This species was transferred to Rauwolfia by Ducke.

PARAHANCORNIA Ducke, Arch. Jard. Bot. Rio Janeiro **3**: 242, as *Parahancornea;* corrected in "Errata et Corrigenda" following p. 272. 1922.

Type species.—*Parahancornia amapa* (Huber) Ducke.

Parahancornia is confined to the tropics of South America. It has been so infrequently collected that no general distribution of its members other than that given under the species is desirable at this time.

Ducke founded his genus Parahancornia on the basis of *Hancornia Amapa*. Hancornia, represented by *H. speciosa*, offers a strong contrast to Parahancornia; it has closely nerved leaves with interpetiolar stipule-like minute glands, corollas with long tubes and relatively short lobes, anthers inserted high up on the corolla-tube near the throat, ovary glabrous, style very long, stigma and stigma-lobes differently shaped from those of Parahancornia.

Ducke (16, p. 242) suggests that Parahancornia be placed next to Couma: "sera a placer entre les genres Hancornia et Couma." Markgraf (35, p. 375) states: "Reiches Material der neueren niederländischen Expeditionen veranlasste mich zu genauen Analysen, auch eines authentischen Exemplars von Ducke, und daraus gewann ich die Überzeugung, das die Gattung zu den primitivsten Apocynaceen überhaupt gehört und in der Nähe von Ambelania Aubl. unterzubringen ist." In my opinion Parahancornia is most closely related to the species in the section of Ambelania with terminal inflorescences.

As seen from the above paragraph, Markgraf conjectures that Parahancornia is a primitive member of the Apocynaceae; in Notizblatt, placing this genus in the same category as Geissospermum, Laxoplumeria, and the "3 Landolphia-Arten Amerikas," he adds: "die aus weit zurückliegenden Zeiten im Amazonenstromgebiet erhalten geblieben sind."

All the species of Parahancornia are closely interrrelated. They might,

however, be placed in three groups. *P. amapa* and *P. peruviana* comprise one set. Of *P. oblonga*, *P. Krukovii*, and *P. amara*, comprising the second group, *P. Krukovii* seems to differ but little from *P. oblonga*. *P. negroensis*, with its small leaves, is outstanding.

The information on Parahancornia is so meager that it is judged best at this time to give the field descriptions and local names as purely empirical data under the species. Note, however, that the vernacular names reported are often the same as those for Couma species.

The latex of Parahancornia is apparently too bitter and much inferior to that of Couma to be used as a basic material in the manufacture of chewing gum. (*P. negroensis* is of interest in this connection, but more so because of its light-weight wood.) The latex of *P. amapa* has been employed as a cicatrisant, in maladies of the intestines and other ailments, particularly in tuberculosis.[12] The wood of *P. amapa* is reported used in joinery. The fruits of this species and also those of its very close relative, *P. peruviana*, are judged savory.

DESCRIPTION AND KEY TO THE SPECIES OF PARAHANCORNIA

(Key-characters printed in italic)

A. Leaves more or less *acuminate* at apex, 5–10 cm. long and 2–4.5 cm. broad; inflorescence with numerous flowers; ovary *roundish* at apex ..... B.
  B. Calyx-lobes *puberulent* on back, as well as ciliate; inflorescence-branches and pedicels puberulent; corolla-tube *densely pubescent* outside; style about 2 mm. long ... 1. *P. amapa*.
  B. Calyx-lobes *glabrous* or nearly so on back, usually merely ciliate; inflorescence glabrous or nearly so; corolla-tube *sparsely puberulent* outside; style *about 1 mm.* long .. 2. *P. peruviana*.
A. Leaves mostly *rounded* at apex, with no acumen or a very short one ..... C.
C. Leaf-blades *oblongish;* ovary conical at apex, the style about length of ovary or shorter ..... D.
  D. Leaf-blades up to 9 cm. long and 5 cm. broad; inflorescence with *numerous flowers;* calyx-lobes densely *pubescent* outside throughout; corolla-tube and lobes *pubescent* outside .... 3. *P. amara*
  D. Leaf-blades 8–12 cm. long and 3–4.5 cm. broad, the midribs sharp on underside especially near base; inflorescence *sparsely or moderately flowered;* calyx and corolla *glabrous* or glabrescent outside ..... 4. *P. oblonga*.
C. Leaves *elliptic or oblanceolate*, usually less than 10 cm. long and 4.5 cm. broad ..... E.
  E. Leaves *elliptic*, 5–10 cm. long and 2–4 cm. broad, chartaceous, the leaf-margins flat, the midrib blunt on underside, the tertiaries obvious; young fruits elliptic, the sepals *persistent* ..... 5. *P. Krukovii*.
  E. Leaves *oblanceolate to obovate*, much narrowed towards the wedge-shaped base and broadly rounded at apex, up to 6.5 cm. long and 3.5 cm. broad, coriaceous, the leaf-margins involute, the tertiaries often obscure; young fruits globose, the sepals *deciduous* ... 6. *P. negroensis*.

1. PARAHANCORNIA AMAPA (Huber) Ducke, Arch. Jard. Bot. Rio Janeiro **3**: 26, in obser., 242. 1922. **4**: pl. 21. 1925.

Hancornia Amapa Huber, Bol. Mus. Para. **3**: 443. 1902.

[12] A. Rathje (53, p. 52) writes: "Die Amapamilch ist ein von den südamerikanischen Indianern des Amazonengebietes hochgeschätztes Heilmittel gegen Schwindsucht." The plant in question is designated by the author as an unknown Brazilian species in the genus Hancornia. That the latex is referred to as Amapa and was procured from the Museu Goeldi in Para, as well as its local use, is strong circumstantial evidence that the species is *Parahancornia amapa*.

Citations by Ducke.—"Obidos (Ducke 11497; Dec., flowers), Almeirim (Ducke 17235; Aug., flowers), Braganca (9803), Marajo (7047), Arama (1866), Rio Moju (7012), Faro (8621)."

Type of *Hancornia Amapa*.—"Arama, bastante frequente na mata e na beira do rio (1866)."

Illustration.—*Parahancornia amapa* (17); leaf, flowers, fruits and seeds, with detailed analysis.

Distribution.—State of Para in Brazil, extending at least to Dutch Guiana. Infrequent or frequent, but not in large groups, on terra firma as well as in high varzea, not rare in periodically inundated land.

Specimens examined.—Brazil, Para: Ducke 11396 (Gurupa; Aug., fls.), undesignated collector 9803 (photo), 11497 (photo). French Guiana: W. E. Broadway 848 (det. doubtful). Dutch Guiana: Forestry Bureau 3916 (July, fls.), 2512.

I have not seen the type of *Hancornia Amapa*, but judging from the description and other evidence it seems to be identical with the material studied by Ducke for his new combination. For a statement as to the possible identity of *Couma fasciculata* R. Ben. with *P. amapa* see remarks under "Species Excluded from Couma."

Large tree with straight trunk; fruit about 3 inch. in diam., slightly verrucose. Local names.—Brazil: Amapa. Dutch Guiana: Amaapa, Dokalli, Mampa.

2. **Parahancornia peruviana** Monachino, sp. nov.

Parahancorniae amapae consimilis sed foliis ca. 8 cm. longis et 3.5 cm. latis, ad apicem rotundatis et breviter caudatis, acumine ipso obtuso ca. 4 mm. longo; pedicellis et ramis inflorescentiarum glabris; corollis minus dense pubescentibus, majoribus, lobis ca. 14 mm. longis; style maturo non 1 mm. longo.

Type: G. Klug 2979, Peru, dept. Loreto, Balsapuerto, alt. about 220 meters, forest; March, 1933. (Deposited in the Britton Herb. NY.)

Distribution.—Known only from the dept. of Loreto in Peru; in forest up to over 720 ft. above sea level, usually in humid areas; not common.

Specimens examined.—Peru, dept. Loreto: Klug 2979 (type coll.; A, G, M, NY); Tessman 3619 (mouth of Rio Santiago; fls.); L. Williams 913 (upper Nanay; A, M).

P. peruviana is very closely related to *P. amapa*, of which it is merely a glabrescent short-styled segregate.

Tree with erect columnar trunk, often 110 ft. tall and 3 ft. in diam. at base, the crown spreading; bark $\frac{1}{2}$ inch or more thick, reddish brown and scaly, the bark and sapwood with copious latex; corolla yellowish white; fruit large, green, with yellowish pulp.

3. **Parahancornia amara** (Mgf.) Monachino, comb. nov.

Couma amara Mgf., Notizbl. Bot. Gard. Berlin 11 (105): 338. 1932.

Type of *Couma amara*.—"Nordbrasilien: Staat Amazonas, Manaos, Cachoeira do Mindu, im Sumpfwald (14. Juni 1929, Ducke 22424)."

Distribution.—Known at present only from the vicinity of Manaos in the Amazon.

Specimen examined.—Brazil, Amazonas: Ducke 502 (Estrada do Aleixo, Manaos; May, fls.).

Medium sized trees with ashy bark; corolla white and fragrant; fruits globose, about 5 cm. in diam., very bitter.

Local name.—Brazil: Marupa de Anta.

4. **Parahancornia oblonga** (Benth.) Monachino, comb. nov.

Couma oblonga Benth., ex Muell. Arg. Linnaea **30**: 390. 1860.

Type of *Couma oblonga*.—"Prope Maypures ad flumen Orenoco (R. Spruce n. 3619 in hb. Mart."

Distribution.—Known at present only from the upper Rio Negro, Brazil, and in the adjacent state of Amazonas, Venezuela; in campos and restinga alta.

Specimens examined.—Brazil, Amazonas, Rio Negro, municip. Sao Gabriel: Froes 414 (Yuco, Rio Xie). Venezuela, Amazonas: R. Spruce 3619 (type coll.; June, fls.; Britton Herb. NY).

Tree about 60 ft. tall and 7 inch. in diam.

5. **Parahancornia Krukovii** Monachino, sp. nov.

Arbor plus 35 m. alta; petiolis brevibus usque ad ca. 4 mm. longis; laminis foliorum ellipticis plerumque 5–10 cm. longis et 2–4 cm. latis, ad apicem subangustatis rotundatisque vel obtusis, ad basin angustatis obtusisque vel subacutis; sepalibus persistentibus.

Type: Krukoff 7189, Brazil, Amazonas, basin of Rio Madeira, municip. Humayta, on plateau between Rio Livramento and Rio Ipixuna, cipoal; Nov. 13, 1934. (Deposited in the Britton Herb. NY.)

Distribution.—Known to date from the basins of Rio Madeira and Rio Negro, Amazonas, Brazil.

Specimens examined.—Brazil, Amazonas: Froes 21 (Rio Negro);[13] Krukoff 7189 (type coll.; A, F, NY), 7224.

Parahancornia Krukovii, known only from fruiting material (fruits up to 3.5 cm. in diam.), resembles *P. oblonga* most closely.

Local names.—Brazil: Sorva do Igapo, Sorvinha.

[13] Froes 21 is represented by two different collections, typical *Couma utilis* and *Parahancornia Krukovii*. It is suggested that only the specimens annotated "Det. Sept. 1943" be accepted as determined.

6. **Parahancornia negroensis** Monachino, sp. nov.

Arbor, ramis griseis, ramulis brunneis ampliatisque; petiolis ca. 5 mm. longis; laminis obovato-oblanceolatis, 4.5–6.5 cm. longis, 2–4 cm. latis, ad apicem rotundatis, basin versus angustatis et in petiolum decurrentibus; inflorescentiis paucifloris (floribus 4–10); pedicellis glabris usque ad 4 vel 5 mm. longis; floribus carnosis; lobis calicis inter se magnitudine variis 1.5–2 mm. longis latisque, ciliatis, extus parce puberulis; lobis corollae extus obscure parceque puberulis, intus basin versus obscure parceque puberulis; ovario (deforme) pubescente, ad apicem rotundato-depresso, pro parte immerso; fructibus globosis, sepalibus caducis.

Type: Froes 800, Brazil, Amazonas, municip. Sao Gabriel, basin of Rio Negro, Matosinho on Rio Uenuichi; March 21, 1942. (Deposited in the Krukoff Herb. NY.)

Distribution.—Known only from the Upper Rio Negro, municip. Sao Gabriel, state of Amazonas, Brazil; scattered or gregarious on caatinga or igapo along rivers, abundant near Matosinho on Rio Uenuichi.

Specimens examined.—Brazil, Amazonas, municip. Sao Gabriel: Adams 50 (Rio Uaupes); Froes 376a (Cucui, Ca-te-espera), 377, 379, 438 & 439 (Santa Ana on Rio Icana), 800 (type).

The type of this species differs slightly from the other specimens cited in that the leaves are less coriaceous, the secondaries clearly visible (up to 15 pairs), connected at the leaf-margins, the tertiaries sometimes apparent. The style is very short (flowers parasitized), the stigma sharply conic.

Tree, up to 65 ft. tall and 7 inch. in diam., the height to the first fork 35 ft.; wood very light. Local names.—Brazil: Coumahy, Coumahy da Caatinga, Cuma, Molongo, Sorva Pequena.

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New and Interesting Agarics from Tennessee and North Carolina

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In the following account one species of Cantharellus, two in Clitocybe, three in Cortinarius and one in Tricholoma are described as new. New varieties are described in *Collybia maculata* (Fr.) Quél. and *Cortinarius pulchrifolius* Pk. Most of the specimens reported on were collected by the authors at Highlands, N. C., or in the Great Smoky Mountains National Park in the period between 1937 and 1942. However, we have included a critical study of *Collybia maculata* and its variants for North America. The specimens cited have been deposited in the herbaria of both the University of Michigan and the University of Tennessee, whenever the collections were ample. The color terms within quotation marks are taken from R. Ridgway, Color Standards and Color Nomenclature, Washington, D. C., 1912. The collection numbers of Smith are designated with an "S" and those of Hesler with an "H."

The Cortinarii of southeastern United States present an interesting though difficult field of investigation. One of the chief difficulties we have encountered is that at the lower elevations they do not fruit in the quantity, i.e., the dozens or hundreds of carpophores, that characterize the species of Cortinarius in northern regions under optimum circumstances. This situation makes it difficult to obtain the desired stages and to be sure that one is not making mixed collections. In the mountains of the South one finds many of the typically northern species, but in areas of low elevations, such as Cades Cove in the Great Smoky Mountains National Park, there appears to be a distinct southern flora. *Cortinarius compressus* and *C. subrimosus* are two representatives of it which seem to be very distinct. How extensive this flora will eventually turn out to be is difficult to predict, but the indications are that it is relatively large. Collections made by Dr. R. P. Burke of Montgomery, Ala., in the vicinity of Montgomery as well as our own collecting experience, bear out the above statement.

LIST OF SPECIES

Cantharellus purpurascens Hesler, sp. nov.

Fig. 1A and 2

Pileus 4–12 cm. latus, planus vel subdepressus, discus ochraceo-aurantius atque salmoneo-aurantius; tractatus vel contusus purpurascens;

* Papers from the Herbarium of the University of Michigan and Contributions from the Botanical Laboratory, the University of Tennessee, N. Ser. 63.

appresso-fibrillosus, siccus, margine aequo. Caro in disco crassa, marginem versus attenuata, alba, si fracta purpurea; odore et sapore miti vel levi. Lamellae decurrentes, angustae, tenues, confertae, furcellatae, albae, si contusae purpureae. Stipes 4–10 cm.×8–20 mm. basin versus attenuatus, pileo concolor, tractatus vel contusus purpurascens, siccus, appresso-fibrillosus, solidus. Sporae (8)9–12(15)×3.5–4.5μ, ellipsoideae, apiculatae.

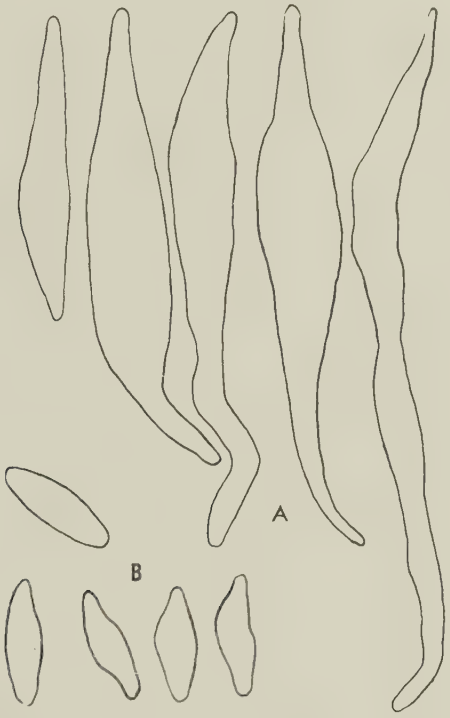

FIG. 1, A. *Cantharellus purpurascens* Hesler. Cystidia×1000.
FIG. 1, B. *Tricholoma fumosifolium* Hesler. Spores×1500.

Basidia tetraspora, 45–55×7–9μ. Cystidia subbrunnea, clavata, subfusiformia, saepe flexuosa, 40–100×7–10μ. Specimen typicum legit prope Bryson City, N. C., Aug. 11, 1940. L. R. Hesler, n. 12,793, in Herb. Univ. of Tennessee conservatum.

Pileus 4–12 cm. broad, plane or slightly depressed, disc "ochraceous orange," elsewhere "salmon orange," staining purplish when handled or bruised, appressed-fibrillose, dry, margin even; flesh thick on disc, thin outward, white, tinged purplish when cut; odor and taste mild or slight; lamellae decurrent, narrow, thin, close, dichotomously forked, white, purplish when bruised; stipe 4–10 cm.×8–20 mm., tapering downward,

FIG. 2. *Cantharellus purpurascens* Hesler. ×1.

concolor to pileus, purplish when bruised or handled, dry, appressed-fibrillose, solid.

Spores (8)9–12(15)×3.5–4.5μ, ellipsoid, apiculate, brownish in iodine, color in mass near "honey yellow"; basidia 45–55×7–9μ, 4-spored. Cystidia brownish, clavate-subfusiform, often flexuous, 40–100×7–10μ. Type specimen collected near Bryson City, Indian Creek, Great Smoky Mts. National Bank, N. C., Aug. 11, 1940, L. R. Hesler, n. 12,793, deposited in the University of Tennessee Herbarium. After being stored for several months, the specimens have assumed a fenugreek odor.

Gregarious to scattered, on soil, in frondose and pine-hemlock woods. In addition to the type, collections (nos. H.-13,977 and H.-14,337) were taken from the same station on August 24, 1941 and August 23, 1942.

Both macroscopic and microscopic characters distinguish this species. The peculiar color change and the conspicuous cystidia seem to be unique in this genus. The thin, narrow gills suggest relationship to *C. aurantiacus* Fr. Clearly, *C. purpurascens* is a clitocyboid species, and it is well known that some authors remove these forms to the genus Clitocybe. But because of the dichotomously forked gills and the cystidia, it seems best to attach it to the genus Cantharellus. No taxonomic purpose would be served by referring this species to Clitocybe.

Clitocybe Cokeri Hesler, sp. nov.

Fig. 4

Pileus 2–5 cm. latus, convexo-planus, depressus, hygrophanus, brunneus vel atro-brunneus, margine nonnumquam striato. Caro scissilis, odore et sapore farinaceo. Lamellae adnatae vel decurrentes, vinaceo-brunneae, confertae vel subdistantes, nonnihil latae, margine aequo. Stipes 3–8 cm. ×3–8 mm., pileo et lamellis concolor, fibrillosus, solidus vel farctus, non viscidus. Sporae (7)8–9(11)×4.5–5.5(6.5)μ, ellipsoideae, leves, apiculatae. Specimen typicum legit prope Knoxville, Tenn., Dec. 15, 1940, L. R. Hesler, n. 12,963, in Herb. Univ. of Tennessee conservatum.

Pileus 2–5 cm. broad, convex-plane, more or less broadly depressed or subumbilicate, in age with a spreading or uplifted margin, hygrophanous, color variable, "deep brownish drab," "dark vinaceous drab," "Vandyke brown," "cinnamon-drab," "Verona brown," or "natal brown," darker when wet, paler when dry, glabrous or minutely fibrillose, not viscid, margin at times striate (wet); flesh medium, concolor, rather firm, scissile; odor and taste farinaceous; lamellae adnate to decurrent, "brownish drab," "purple drab," "vinaceous drab," "deep dull lavender," "dark vinaceous-gray" to nearly "snuff brown" in age, medium close to subdistant, many short, medium broad, narrow behind, broader in front, at times forked and anastomosed at base, edges even; stipe 3–8 cm.×3–8 mm., equal or tapering upward, concolor with pileus or lamellae, white

FIG. 3. *Cortinarius pulchrifolius* var. *odorifer* Hesler. $\times\frac{3}{4}$. (No. 14, 339, Type.)

fibrillose (with a silvery hue), solid or stuffed with a white pith, or becoming hollow, not viscid.

Spores (7)8–9(11)×4.5–5.5(6.5)μ, ellipsoid, smooth, apiculate; basidia 36–54×(6)8–10μ; cystidia none; gill trama of nearly parallel hyphae, 4–7.5μ in diameter.

Scattered on soil in deciduous or coniferous woods, October to January, eastern Tennessee and Oregon.

The type (University of Tennessee Herbarium no. 12,963) was taken from a pine woods near Knoxville, Anderson County, Tenn., by Hesler Dec. 15, 1940. Other collections also by Hesler: No. 10,201 pine woods, type station, Jan. 10, 1937; 10,206, under beech and laurel, Oliver Springs, Dec. 1, 1934; 13,040, oak woods, Cades Cove, Great Smoky Mts. National Park, Dec. 19, 1940; 13,172, mixed woods, type locality, Dec. 27, 1941; 14,138, same, Jan. 25, 1942; 15,211, New Hopewell, Knox Co., Dec. 24, 1942. Smith no. 14,149 under fir and yellow pine, Sisters, Ore., Oct. 29, 1941 may also belong here. He found a pale lilac mycelium at the base of the stipe.

Observations: In the size and shape of the pileus, in the character of its spores and in its scissile flesh, a relationship to *C. cyathiforme* Fr. is strongly suggested. But in the predominance of its lavender to vinaceous coloring and in its farinaceous odor and taste, it is strikingly different. The gill coloring is strongly suggestive of that in some forms of *C. laccata* Fr.

Using KOH-phloxine stain and oil immersion lens a rough spore wall was not demonstrated.

Coker and Beardslee (1922) have described the same or a similar species under the name *C. cyathiformis* (Bull.) Fr., but they recognized the difficulty of referring their collection to this binomial on account of the distinct farinaceous taste. Material of their plant (no. 4934) has been examined, but the state of its preservation prohibits critical comparison. From the description and illustrations, it seems certain that they worked with *C. Cokeri.*

Singer (1942) in his discussion of *C. violaceifolia* Murr. mentioned three species with similarly colored gills, namely *C. violaceifolia*, *C. lilacifolia* (Pk.) Singer and *C. hyacinthina*, the latter from Asia. *C. lilacina* Massee from Tasmania should also be added to this list. Since we have seen fresh material of only one of these, *C. lilacifolia*, we shall not attempt to do more than evaluate the two American species. Peck's *Omphalia lilacifolia* (Clitocybe sensu Singer) is sharply distinct from *C. Cokeri* by virtue of its viscid pileus and stipe and habitat on conifer logs. *C. violaceifolia* presents a somewhat more difficult problem since we have not seen the type. Murrill described it as having a slightly viscid, smooth and glabrous pileus, a smooth glabrous grayish violet stipe and habitat on decaying wood. Singer, who studied the types pronounced the two closely related but did not clear

up the point of whether or not the pellicle in Murrill's species was gelatinous. However, in view of Singer's comments and Murrill's description, it is quite evident that *C. Cokeri* must be regarded as distinct, since under no circumstances could it be regarded as closely related or even similar in aspect to *O. lilacifolia*. *C. Cokeri* is one of the small to medium sized terrestrial pinophilous species.

Clitocybe highlandensis Hesler et Smith, sp. nov.

Pileus 4–11 cm. latus, convexus mox planus vel subdepressus, glaber, udus, substriatus, albidus demum subalutaceus; lamellae adnatae demum subdecurrentes, subconfertae vel subdistantes, latae, albidae; stipes 4–8 cm. longus, 8–16 mm. crassus, farctus demum cavus, sursum pruinosus, albidus, deorsum spongiosus; sporae 4–5×2–2.5μ. Specimen typicum legerunt L. R. Hesler et A. H. Smith n. 7537, prope Highlands, N. C., Sept. 10, 1937; in Herb. Univ. of Mich. et Univ. of Tennessee conservatum.

Pileus 4–11 cm. broad, convex, becoming expanded to plane or the disc becoming somewhat depressed, glabrous, white or dingy white when young, becoming pale tan at least over the central portion in age, margin even or slightly striate, surface merely moist, soon dry; flesh thick under the disc, thin along the margin, white, odor none, taste mild at first, tardily becoming slightly bitter; lamellae when young adnate, becoming slightly emarginate and with a decurrent tooth, moderately close to subdistant, 50± reach the stipe, 3–4 tiers of lamellulae, broad and in age ventricose (12 mm.±), white and unchanging; stipe 4–8 cm. long, 8–16 mm. thick, stuffed, becoming hollow, tapering upward slightly, white, apex pruinose to furfuraceous, strigose over the enlarged spongy base.

Spores 4–5×2–2.5μ, ellipsoid, smooth, not amyloid; basidia four-spored, 18–22×3.5–4.5μ; pleuro- and cheilocystidia not differentiated; gill trama interwoven, not amyloid; pileus trama loosely interwoven, hyphae 8–15μ in dia., cuticle 30–100μ thick, of compactly arranged hyphae more or less radially arranged and 5–8μ thick, no clamp connections seen.

Gregarious under pine, Highlands, N. C., Sept. 10, 1937, L. R. Hesler and A. H. Smith no. 7537.

Observations: The outstanding characters of this species are the very small narrowly ellipsoid smooth spores, the white color of all parts of the young fruiting body, the change to tan exhibited by the pileus in age, and the broad almost subdistant gills. The attachment of the latter is such that the species could be placed in either Tricholoma or Clitocybe depending on which stage of development was encountered. The base of the stipe is enlarged and somewhat spongy, and in this respect the species simulates *C. regularis* Pk. *C. phyllophila* sensu Lange is distinguished by its broader spores and by the base of the stipe not being spongy and not enlarged. *C. catina* Fr. sensu Ricken fits our collection in certain respects but differs

markedly in the shape of the pileus, the habitat and decidedly decurrent gills. This last character coupled with Fries' emphasis on the relationship of *C. catina* to *C. infundibuliformis* definitely excludes our species. *C. highlandensis* is related to *C. cerrussata* and *C. regularis* but is fleshier than either. *C. tornata* sensu Ricken differs in its rivulose pileus, smaller size and lack of spongy mycelium at the base of the stipe.

COLLYBIA MACULATA (Fr.) Quélet, Champ. Jura et Vosges, p. 341. 1872.

The variants of this species found in North America present a very interesting though puzzling series. In the following account, they are brought together in a comprehensive manner for the first time. A key is given here to aid in their identification:

KEY TO THE FORMS AND VARIETIES OF C. MACULATA IN NORTH AMERICA

1. Spores up to 6μ long, typically subglobose to globose, relatively few ellipsoid 2
1. Spores up to 7μ long, typically ellipsoid, relatively few globose to subglobose 3
2. Gills white, soon reddish spotted. Taste bitterish ..... var. *typica*
2. Gills yellow ..... forms of var. *scorzonerea*
3. Carpophore with reddish to ferruginous stains in some part 4
3. Carpophore lacking reddish stains 6
4. Gills yellow or yellowish at least at maturity ..... var. *scorzonerea*
4. Gills white (except for stains) 5
5. Odor of musk very strong ..... var. *moschata*
5. Odor lacking or very faint, not of musk ..... var. *occidentalis*
6. Gills white ..... var. *leucocephala*
6. Gills yellowish ..... var. *immaculata*

C. MACULATA var. TYPICA

Pileus 5–9 cm. broad, obtuse to convex with an inrolled margin, surface at first covered by a whitish canescent coating, soon glabrous or whitish-canescent only along the margin, surface moist but opaque, not hygrophanous and not truly viscid, color pallid to evenly pale "cinnamon" (pale tan) at first, with scattered rather large polished spots of about the same color, fading slowly as expansion takes place, at maturity "pale pinkish buff" or whitish and usually stained reddish to ferruginous; flesh white, thick, firm, taste bitter or tardily bitterish, odor none or very faint; lamellae crowded and narrow (narrower than the thickness of the flesh of the pileus), adnate, "pale pinkish buff" when real young, soon white or whitish and becoming stained reddish brown particularly along the edges or where bruised; stipe 8–10 cm. long, 8–12 mm. thick, slightly narrowed downward and subradicating, base white cottony tomentose, upper portion evenly white pruinose, fibrillose or with a thin appressed tomentum, glabrescent and longitudinally striate in age, white to sordid whitish and soon stained rusty at the base.

Spores 4.5–5.5(6) $\times$ 3.5–4.5(5)μ, typically subglobose but varying either to globose or ellipsoid, smooth, hyaline under the microscope, cream color in deposit, not amyloid; basidia 20–24 $\times$ 5.5–7μ, four-spored, clavate;

FIG. 4. *Clitocybe Cokeri* Hesler. ×1. (No. 12,963, Type.)

pleurocystidia if present not projecting beyond the basidia and subfusoid in shape (these may be immature basidia); cheilocystidia 10–18(26)×2.5–4μ, filamentose or somewhat contorted, very inconspicuous; gill trama regular or slightly interwoven, not amyloid, subhymenium thin and much branched; pileus trama with a compactly interwoven layer of surface hyphae 3–5μ in dia., their walls very slightly gelatinous, the remainder of the trama loosely interwoven, the hyphae 6–12μ in dia., clamp connections present.

Gregarious under pine, Highlands, N. C., Aug. 21, 1938, L. R. Hesler and A. H. Smith no. 10,382. The above description was taken from this collection.

Observations: The viscidity mentioned by Coker and Beardslee (1921) is doubtless caused by the very slight gelatinization of the cuticle, but the species is not viscid in the sense that it has a truly gelatinous pellicle. The above collection departed slightly from the traditional concept of the species in having pale buff to pale tan pilei at first. During the season of 1934 a series of collections (S-204; S-427; S-573) was obtained in the Adirondack Mts. of New York. All had white to whitish pilei, spots and stains somewhere on the carpophores and spores 5–6×3.5–5μ. In another series from southeastern Michigan (S-11,032; S-15,428; S-15,466), the spores were 4.5–6×(3.5)4–5(5.5)μ. These had white pilei, but were all mature or had been standing for some time before being collected. The buff to tan colors appear to be characteristic of moist young specimens. Rea (1922) described the cap as white and cited Cooke's plate, Illus. no. 186, t. 142, which depicts a fungus the color of our North Carolina collection. Lange (1936) illustrated both the colored and the pale form. Since the specimens fade to white rather soon, we prefer to regard the observed difference in color as variation probably caused by the rate of development and the weather conditions.

The shape of the spores is often difficult to determine. One must not make his observations on spores suspended in the mounting fluid. Frequently they have a very pronounced apiculus which changes their shape from globose to drop-shaped. Because of the variability of the shape of the spores in typical material, it does not appear justifiable to maintain forms with typically ellipsoid spores as distinct species. Intergrading forms such as Smith no. 862 are known. Its spores measure 5–6.5×4–4.5μ.

C. MACULATA var. MOSCHATA Lovejoy, Bot. Gaz. **50**: 384. 1910.

Pileus fleshy, firm, 6 cm. wide, convex to nearly plane, white, glabrous, shining, becoming tinged or stained with pinkish red blotches, disk sometimes broken up into large polygonal plates; margin turned down and even; flesh white, compact, tinged with pink just beneath the surface: lamellae whitish, in one specimen a faint pink tinge, adnexed to nearly free; stipe stout, firm: 3 cm. long, 2 cm. wide, swollen in the middle, stuffed, becoming hollow, curved, narrowed at base, striate, slightly roughened by broken fibers, spores white, smooth, sometimes with a slight point at one end, 7×4μ. It has a strong almost over powering odor of musk.

Habitat: On side of dead lodgepole pine log, clustered; Foxpark, Wyoming, alt. 2900 meters, August 13, 1909. no. 79.

Observations: We have not seen material, but the variety appears distinct by virtue of its strong odor and clustered habit. The spores place it closest to var. *occidentalis*.

✓ **C. maculata** var. **occidentalis** Smith, var. nov.

Lamellae subconfertae, latae; sporae 5–7×3.5–4.5μ, ellipsoideae. Specimen typicum legit A. H. Smith n. 17,539, prope Mt. Angeles, Olympic Mts., Wash., Oct. 4, 1941; in Herb. Univ. of Michigan conservatum.

Pileus 3–8 cm. broad, convex with an inrolled margin, becoming nearly plane, surface moist or at first very faintly hoary, not viscid, white or with a faint pink or buff tinge at first, in age reddish spotted; flesh pliant, whitish, odor faint, taste bitterish; lamellae close but not crowded, white, usually stained reddish in age, narrow but becoming rather broad, adnate becoming rounded-adnexed; stipe 4–10 cm. long, 8–12 mm. thick, equal or ventricose below and then tapered to a short pseudorhiza, soon hollow, surface longitudinally striate, unpolished, white or whitish and usually reddish spotted at least in age.

Spores 5–7×3.5–4.5μ, ellipsoid. The remainder of the microscopic characters are as given under var. *typica*.

Shuksan Inn, Mt. Shuksan, Wash., Aug. 18, 1941 (S-16,248); Mt. Angeles, Olympic Mts., Wash., Sept. 21, 1941 (S-17,119) and again on Oct. 4 (S-17,539-type); Sol Duc Falls, Olympic National Park, Oct. 6 (S-17,600); Mt. Angeles Oct. 20, 1941 (S-18,069). All of these were either on humus or around very decayed conifer logs. Kauffman's collection, identified as *C. maculata*, from Lake Cushman, Wash., has spores 5–7 ×3.5–4μ and also belongs here.

Observations: This variety differs from typical material in the slightly but consistently larger more ellipsoid spores and the less crowded broader gills. The pilei may or may not have a buff tinge at first. One intermediate form between var. *typica* and var. *occidentalis* was found on a conifer log, Boulder Lake Trail, Olympic National Park, Wash., May 28, 1939, 4500 ft. elev. (S-13,830). Both cap and gills were tinged pinkish buff, and the spores were typically subglobose, 5.5–7×4–5.5μ.

C. MACULATA var. SCORZONEREA (Fr.) Gillet, Cham. Fr. p. 315. 1878.

Pileus 5–10(15) cm. broad, broadly convex with an inrolled margin at first, becoming plane or in age the margin recurved somewhat, surface moist, glabrous, with scattered circular watery spots, color "light pinkish cinnamon" (pale buff) and fading to "pale pinkish buff" (not truly white), occasionally fading to "ivory yellow" (pale yellow) over all but the disc; flesh thick (1–1.5 cm.), firm, pliant, pallid, odor somewhat fragrant, taste bitterish; lamellae yellow or soon becoming so ("cream-color" to "marguerite yellow"), narrow (5 mm.±) but becoming up to 10 mm. in large caps, depressed-adnate, close but not crowded, 65± reach the stipe, 2–4

tiers of lamellulae, edges even or slightly eroded and often stained reddish; stipe 5–8(12) cm. long, 6–10(15) mm. thick, equal or narrowed below, hollow, with rhizomorphs attached to the base, sometimes rooting, concolorous with the pileus and longitudinally striate, frequently stained reddish brown.

Spores 5.5–7(8)×4–5μ, typically ellipsoid. The other microscopic characters are as given under var. *typica*.

On a conifer log, Lake Crescent, Wash., June 4, 1939 (S-14,042); on conifer debris on the ground, Crystal Ridge, 5000 ft. elev., Olympic National Park, Wash., June 17 (S-14,419); on conifer debris, Heart O' Hills, Mt. Angeles, Olympics, Wash., June 19, 1939 (S-14,445); on a conifer log, Sol Duc Hot Springs, Olympic National Park, June 24, 1939 (S-14,653); Heart O' Hills, June 28, 1939 (S-14,673); Hurricane Ridge, Olympic National Park, July 7, 1939 (S-14,856).

Observations: In collection 14,042 the gills were white at first but soon became yellow. Hesler (no. 12,913) from Cades Cove, Tenn., in the Great Smoky Mts. National Park, found this same variety in mixed hemlock and deciduous woods. The spores of his collection measure 6–7×3.5–4μ. In a collection from Lake Crescent, Wash., Smith no. 14,818, the spores are 6–7×3.5μ. The pilei were 2–3 cm. broad, "cinnamon-buff" on the disc, "ivory yellow" toward the margin, and the stipe had a long tapered pseudorhiza. Above the ground the stipe was yellowish ("colonial buff"). The odor was faint but penetrating and the taste disagreeable. The gills were yellow and many were forked. Aside from the forked gills, these carpophores appear to represent var. *scorzonerea* of European descriptions. In the light of the series of collections cited above, however, these fruiting bodies appeared to be merely depauperate specimens.

Var. *scorzonerea* apparently is rare in northeastern North America. We have one collection on larch debris from Ann Arbor (S-15,429). Krieger obtained the material for his unpublished painting from Needle Point, Ontario, Canada (Kelly no. 1240). Kauffman had examined two collections from Wayne County, Mich. (in the year 1907). In Krieger's and Kauffman's collections the spores are up to 7μ long. In no. S-15,429 they are 5–6×4μ and many closely resemble those of var. *typica* in shape. In summary, it can be said that at least in North America var. *scorzonerea* is extremely variable in size and to a lesser degree in color and in the size and shape of the spores.

C. maculata var. **immutabilis** Smith, nom. nov.

(*Collybia leucocephala* sensu Bres., Icon. pl. 195, vol. 4. 1928.)

Tricholoma leucocephalum Fr. is now generally regarded as a rough spored fungus and quite distinct from the one illustrated and described under that name by Bresadola. Singer (1942) considers this to be identical with or very close to *Collybia leucocephaloides* (Pk.) Singer. We do not

know the latter, but to judge from the original description its cap is grayish brown and the taste farinaceous, two characters which should distinguish it from Besadola's fungus. Peck's type was collected at Delmar, N. Y. The specimens Singer studied were collected by Peck at North Elba. Since Peck, in addition to the characters mentioned above, described his species as hygrophanous, it is apparent that a critical study of the type should be made in order to exclude the possibility that it represents a species of Lyophyllum.

C. MACULATA var. IMMACULATA Cke. Illus. no. 187, t. 221. 1881.

Rea (1922) states of this variety: "Differs from the type in *not being spotted*, and in the broader gills." "Pine woods, Aug.–Oct. not uncommon (v.v.)." When Cooke's plate of the variety is compared with existing descriptions, particularly that of Rea, there appears to be a discrepancy in the color of the gills. Actually, however, neither Cooke nor Rea mentioned gill color in their descriptions, so one is forced to rely on Cooke's plate, and to interpret the variety as having distinctly yellowish gills. Cooke also illustrated the spores as ellipsoid. These characters clearly indicate that var. *immaculata* is closest to var. *scorzonerea*. The report of the latter by Peck (1896) very likely applies to var. *immaculata* and his report of var. *immaculata* is probably of var. *immutabilis*.

Cortinarius compressus Smith, sp. nov.

Pileus 2–4(5) cm. crassus, convexus, sericeo-fibrillosus, subavellaneus dein pallide subluteus; lamellae purpureo-griseae, confertae, angustae; stipes brevissimus 1–2(3) cm. longus, 10–15 mm. crassus, marginato-bulbosus, subvolvatus, violaceo-albidus et sericeus; sporae 6–7.5(8)×3.5–4(4.4)μ.—Specimen typicum A. H. Smith n. 9912, legit prope Laurel Falls, Great Smoky Mts. National Park, Tenn., Aug. 8, 1938; in Herb. Univ. of Michigan and Univ. of Tennessee conservatum.

Pileus 2–4(5) cm. broad, convex with an inrolled margin, becoming broadly convex, surface moist beneath a silky fibrillose covering, whitish (from fibrils) over the marginal area and disc, with a decided hoary sheen caused by the fibrils, somewhat glabrescent, more or less "avellaneous" to "fawn color" on the disc, hygrophanous, fading to "pinkish buff" (avellaneous to pale vinaceous brown fading to pale buff), margin hung with universal veil remnants, veil white at first but discoloring to pale buff in age; flesh thick, "vinaceous lavender" (pale lavender) but soon fading to whitish, odor none, taste mild; lamellae "pale purple drab" when young (purplish gray), near "fawn color" (vinaceous brown) or more brownish at maturity; close, narrow, rounded adnate, edges even; stipe very short to almost lacking (1–2–3 cm. long), 10–15 mm. thick at the apex, with a flaring abrupt bulb, universal veil remnants leaving a ring (almost volva-like) around the margin of the bulb, numerous white rhizomorphs around

the somewhat pointed base, color silvery violaceous white from the dense coating of fibrils, flesh within concolorous with that of the pileus.

Spores 6–7.5(8)×3.5–4(4.4)μ, ellipsoid, roughened slightly, dark rusty brown under the microscope; basidia four-spored, hyaline in KOH; pleuro- or cheilocystidia not seen; gill trama slightly interwoven to parallel, hyaline to pallid brownish in KOH; pileus trama with hyaline narrow hyphae from veil over surface, beneath these filaments a region of slightly enlarged pale brownish hyphae, the remaining tissue filamentose and floccose.

Subcespitose under oak and chestnut, Laurel Falls, Great Smoky Mts. National Park, Tenn., Aug. 8, 1938 (S-9912).

Observations: The stature of this species is very distinctive but helps to keep the carpophores hidden effectively under the leaves. It appears to be closely related to *C. fumosifolius* Smith but differs in its violaceous colors among other characters. The manner of its development and the copious universal veil are similar in both. It is distinguished from the series of species in the subgenus Inoloma characterized by marginate bulbs by its truly hygrophanous pileus.

Cortinarius subaustralis Smith et Hesler, sp. nov.

Pileus 5–12 cm. latus, convexus vel subplanus, siccus, fibrillosus, alutaceus dein fulvus; lamellae confertae, angustae, adnatae vel subdecurrentes, albidae dein alutaceae vel fulvae; stipes 8–15 cm. longus, 1–2.5 cm. crassus, clavatus, albidus dein pallide alutaceus; sporae 6–7.5×3.5–4μ; pleurocystidia 50–70×8–10μ, subventricosa. Specimen typicum L. R. Hesler n. 14,336; legit prope Indian Gap, N. C., Great Smoky Mts. National Park, July 14, 1942; in Herb. Univ. of Michigan et Univ. of Tennessee conservatum.

Pileus 5–12 cm. broad, obtuse to convex, becoming nearly plane, the margin sometimes uplifted and wavy, surface dry, more or less appressed-fibrillose, smooth over the disc, rather coarsely fibrillose toward the margin or minutely fibrillose-punctate or slightly tomentose scaly (when dried slightly scurfy), buff to alutaceous ("cinnamon-buff" to "clay color") young, near cinnamon-brown in age ("tawny" to "russet"), and retaining this color when dried; flesh thick, hard, whitish to pale buff, odor and taste not distinctive; lamellae crowded, narrow (8–9 mm.), equal, adnate or subdecurrent, white at first, then buff to "clay color" (alutaceous) and finally nearly concolorous with the pileus, edges remaining paler and often becoming uneven; stipe 8–15 cm. long, 1–2.5 cm. thick at apex, clavate or tapered below, solid, whitish to pale buff and with a fibrillose superior ring when young, white-cottony around the base, merely fibrillose and sordid in age.

Spores 6–7.5×3.5–4μ, very pallid tawny under the microscope, nearly smooth, somewhat almond-shaped; basidia four-spored; hyaline to pallid brownish in KOH; pleurocystidia abundant to scattered, 50–70×8–10μ, subcylindric to subfusiform, originating from lactiferous hyphae in the

gill trama and hardly projecting beyond the basidia unless the tips become elongated into a filamentose proliferation, usually filled with an amorphous opaque substance (when revived in KOH); cheilocystidia similar, more frequently proliferated at the apices; gill trama pallid brownish, parallel to subparallel; pileus trama homogeneous, the hyphae near the surface with tawny walls.

Scattered to gregarious, Flat Creek, N. C., Great Smoky Mts. National Park, Tenn., Aug 28. 1938, Hesler and Smith 10,570; Indian Gap, N. C., also in the Park, July 12, 1942 (H-14,336, type).

Observations: C. subaustralis appears to be most closely related to *C. whitii* Pk. but differs in the shape and size of the spores as well as in having the peculiar pleurocystidia. *C. pseudobolaris* Maire also has cystidia but is readily distinguished by its changing color when bruised and paler colors when young. The dried specimens are readily separated by their different colors. Heim and Romagnesi (1934) have described somewhat similar cheilocystidia for *C. infucatus* Fr. That species, however, differs in size, in having yellow gills and in being rather closely related to *C. cinnamomeus*.

Cortinarius subrimosus Smith et Hesler, sp. nov.

Pileus 4–7 cm. latus, convexus, siccus, sericeo-fibrillosus, rimosus; sapor subamarus; lamellulae pallido-alutaceae, confertae; stipes 4–6 cm. longus, 15 mm. crassus, marginato-bulbosus, albidus; sporae 7–8×4–4.5μ.— Specimen typicum, n. S-14,903, Hesler et Smith legerunt prope Cades Cove, Great Smoky Mts. National Park, Tenn., Aug. 20, 1939: In Herb. Univ. of Michigan et Herb. Univ. of Tennessee conservatum.

Pileus 4–7 cm. broad, broadly convex with an inrolled margin, surface dry and covered by a dense coating of innate appressed silky fibrils, rimose along the margin at times or splitting radially, margin occasionally decorated with fibrillose remnants of the broken veil; flesh thick, soft, shot through with watery streaks, whitish, fading and then near "cinnamon-buff" (becoming slightly yellowish), taste disagreeable, odor distinctly fragrant; lamellae sordid white to pallid brownish when young, "clay color" (alutaceous) in age, narrow (5 mm.±) but no real old pilei found, close to crowded, very slightly sinuate, edges even; stipe 4–6 cm. long, 15 mm. thick at the apex, base enlarged to an abrupt flaring marginate bulb, solid, flesh concolorous with that of cap but retaining its watery streaks longer, bulb more or less covered with the remains of the white fibrillose universal veil, cortina copious and white, upper part of stipe with white silky fibrils on an avellaneous background.

Spores 7–8×4–4.5μ, narrowly ellipsoid, roughened, rusty brown under the microscope; basidia four-spored, hyaline in KOH; pleuro- and cheilocystidia not seen; gill trama regular, hyaline in KOH; pileus trama with a thick tangled layer of nongelatinous hyaline narrow (2–3.5μ) hyphae forming the cuticle, the tramal body made up of larger elements some of which have a faintly brownish incrusting pigment.

Gregarious under pine and oak, Cades Cove, Great Smoky Mts. National Park, Tenn., Aug. 20, 1939 (Hesler and Smith 14,903).

Observations: This species is very close to *C. argentatus* but differs in having a marginate abrupt bulb, smaller spores, a disagreeable taste, and lack of any violaceous or lilac tints. The watery flesh might lead some to place it in Telamonia, but its relationships appear to be in Inoloma. Many of the species considered typical of Inoloma have watery punctate flesh. *C. ochroleucus* has some of the characters of *C. subrimosus*, but differs in lacking a marginate bulb, a conspicuous universal veil and a fragrant odor. *C. albidifolius* Pk. lacks the marginate bulb and has a yellowish universal veil, but is apparently quite similar in other respects.

Cortinarius pulchrifolius var. **odorifer** Hesler, var. nov.

Fig. 3

Pileus 5–8 cm. latus, convexus vel late convexus, siccus, fibrillosus, pallide griseo-cinnamomeus vel avellaneus; odor fragrans; sapor mitis; lamellae emarginatae, confertae, latae, purpureae dein testaceae; stipes 5–7 cm. longus, 9–11 mm. crassus, clavatus, griseo-violaceus; sporae 9–11(12)×6–7μ.—Specimen typicum legit L. R. Hesler n. 14,339, Sept. 3, 1942, Highlands, N. C., in Herb. Univ. of Mich. et Univ. of Tenn. conservatum.

Pileus 5–8 cm. broad, convex becoming broadly convex to plane, neither viscid nor hygrophanous, surface covered by a dense coating of white appressed fibrils, brown beneath the fibrils, the dominant color tone a pinkish gray-brown because of the masking effect of the fibrils; flesh thick on the disc, tapered to the margin, pale watery brown, odor pleasant, resembling spice or ripe pears, taste mild; lamellae emarginate, at first moderately close, broad, when young "dark purple-drab" and becoming "burnt umber" (deep purplish becoming deep testaceous), edges undulating; stipe 5–7 cm. long, 9–11 mm. thick, somewhat bulbous at first, clavate to nearly equal in age, solid, grayish violet within, surface tinged purplish, becoming dingy, fibrillose, cortina copious and hardly distinct from the fibrils of the universal veil, sometimes leaving an inferior fibrillose zone just above the bulb.

Spores 9–11(12)×6–7μ, ellipsoid, slightly curved toward the apiculus in one view, roughened, dark rusty brown in KOH; basidia four-spored, pinkish in KOH; cheilocystidia none seen; gill trama regular, nearly hyaline in KOH; pileus trama homogeneous, pallid in KOH.

Gregarious in frondose woods, Highlands, N. C., L. R. Hesler, no. 14,339, Sept. 3, 1942.

Observations: Although *C. pulchrifolius* does not appear to be a well known species, there is no question of the relationship of the variety described above. It differs from typical material in its slightly closer gills and in having a fragrant odor when fresh. Kauffman separated *C. subpulchrifolius* from *C. pulchrifolius* largely on the basis of the well developed universal veil of the former and its absence in the latter. Since Peck de-

FIG. 5. *Tricholoma fumosifolium* Hesler. ×1. (No. 12,960, Type.)

scribed the cortina as copious, it is very likely similar to that found in the Highlands collection. The presence of copious white fibrils over the pilei in both strengthens the assumption that a universal veil is present in *C. pulchrifolius*. *C. pulchrifolius* Pk., *C. subpulchrifolius* Kauff., *C. obliquus* Pk., *C. rimosus* Pk., and *C. rubrocinereus* Pk. form a group of species very closely related to each other. Smith (1942) has described a form of *C. obliquus* with a fragrant odor. It differs from the above variety of *C. pulchrifolius* in its abrupt bulb at maturity as well as in the manner of development.

CORTINARIUS SANGUINEUS Fr., Epicr. Syst. Myc. p. 288. 1836.

Pileus 3–6(9) cm. broad, convex to obtusely conic, in age conic umbonate or broadly convex to plane, surface dry and innately fibrillose, furfuraceous toward the margin from numerous small recurved fibrillose scales, disc smooth, color "Brazil red" (deep scarlet) or in some the disc "Garnet brown" (almost maroon), color scarcely changing in drying; flesh thick (5–7 mm.), firm, "old rose" (deep pinkish) and hardly changing in age, odor and taste not distinctive; lamellae "English red" (deep reddish orange) or darker, with a changeable sheen, narrow (up to 7 mm.), more or less equal, close to crowded (40–54 reach the stipe, 2–3 tiers of lamellulae), bluntly adnate and becoming somewhat adnexed, edges even; stipe 5–8 cm. long, 4–8 mm. thick, equal, base with yellow mycelium, solid, dark reddish within except for a narrow cortex, surface evenly "orange rufous" (bright orange) or with darker reddish fibrils, becoming sordid reddish brown in age in places but not dark reddish at first.

Spores narrowly ellipsoid, 6–7.5×3.4–4μ, slightly roughened, dull rusty brown in KOH; pleuro- and cheilocystidia not differentiated (no metalloid basidia-like bodies seen in hymenium); basidia four-spored, rosy pink in KOH; gill trama regular, rosy pink in KOH at first but color soon washing out (a copious pink pigment diffuses through the mount), no patches of amorphous pigment comparable to those found in *C. malicorius* present.

Subcespitose on sandy soil under brush near hemlock, Elkmont, Great Smoky Mts. National Park, Tenn., L. R. Hesler, Aug. 15, 1939 (S-14,870).

Observations: The circle of forms, varieties or species centered around *C. sanguineus* is large and one frequently finds intermediates which do not "fit" any of the descriptions. The collection described above differs from *C. sanguineus* as the latter is usually interpreted in the United States. The stipe is orange toward the apex instead of concolorous with the pileus, and the pileus is covered with small scales toward the margin. *C. sanguineus* is frequently described as somewhat scaly, although we have not found it to be so in our collections from other localities. However, since the collection cited above contained larger carpophores than one usually encounters in this species, the scaliness may be merely a variation correlated with the difference in size. The point needs further study from additional material. *C. phoeniceus* differs in not having a dark red pileus, and *C. anthracinus* sensu Lange has much larger spores.

Tricholoma fumosifolium Hesler, sp. nov.

Fig. 1B and 5

Pileus 3–9 cm. latus, viscidus, olivaceo-brunneus vel subbrunneus, appresso-fibrillosus, hygrophanus, saepe zona aquosa marginali. Caro alba, odore et sapore fungoso. Lamellae emarginatae, paululum arcuatae, confertae, latiores, semper griseo-brunneae. Stipes 6–9 cm. × 1–2 cm., pallidus vel albidus, fibrillosus, spongiosus demum cavus. Sporae 7.5–10 × 3–4μ, fusiformes vel ellipsoideae, leves, albae. Specimen typicum legit prope Knoxville, Tenn., Dec. 15, 1940, L. R. Hesler, n. 12,960, in Herb. Univ. of Tennessee conservatum.

Pileus 3–9 cm. broad, viscid, at times glutinous, convex, at first "pale ochraceous-salmon" then "tawny olive" to "ochraceous tawny" or "buckthorn brown," appearing glabrous but with appressed fibrils, hygrophanous, more or less watery-spotted, often with a conspicuous marginal watery zone, margin with short, coarse striae, often wavy, flesh white, medium thick on disc, thin toward margin, odor and taste fungoid; lamellae emarginate and slightly uncinate, somewhat arcuate, close, rather broad, scarcely reaching margin, many short, about 5 ranks, "wood brown" then "drab" or "light drab," unchanging, edges even; stipe 6–9 cm. × 1–2 cm., slightly compressed, equal, pallid whitish, fibrillose, base strigose and white mycelioid, somewhat striate, base curved, spongy-solid then hollow, dry, at first with a slight fibrillose "ring."

Spores 7.5–10 × 3–4μ, fusiform to elliptical-subfusiform, smooth, white in mass; basidia 34–38 × 5.5–6.5μ; pleuro- and cheilocystidia none; trama of rather narrow, undulating-parallel hyphae, surface of pileus of interwoven hyphae.

The type (no. 12,960) was collected in humus, pine woods near Knoxville, Anderson County, Tenn., Dec. 15, 1940. Additional collections were subsequently taken from the type station (in Dec. and Jan., nos. 14,104, 15,210 and 15,223 all by Hesler) and from Knox County, Dec. 1942 (H-15,215). The coloring of the pileus and lamellae, and the fusiform, smooth spores are distinguishing characteristics.

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The Subgenera of Crossocerus With a Review of the Nearctic Species of the Subgenus Blepharipus

(Hymenoptera: Sphecidae: Pemphilidini)

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The genus *Crossocerus* is a complex of about one hundred described species. Representatives of it occur in nearly every major zoogeographic region. The component forms are very protean in their diagnostic features, and arrange themselves in a great number of natural groups, many of which are so distinct that they are worthy of being accorded subgeneric rank. Unfortunately, however, most of these subgenera are very imperfectly known: their limits, diagnostic characters, and distribution are often not fully apprehended, and their nomenclature is frequently misunderstood. The present exposition and tentative subgeneric synopsis is an attempt to solve a number of the taxonomic problems involved in, and arising from a study of the genus *Crossocerus*.

Crossocerus Lepeletier & Brullé

≧*Crossocerus* Lepeletier & Brullé, Ann. Soc. Ent. France, III, p. 763, (1835).
≧*Blepharipus* Lepeletier & Brullé, Ann. Soc. Ent. France, III, p. 728, (1835).
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Genotype: *Crabro scutatus* Fabricius, 1787 [=*Sphex palmaria* Schreber, 1784=*Sphex palmipes* Linnaeus, 1767=*Crossocerus* (*Crossocerus*) *palmipes* (Linnaeus)]. (By designation of Ashmead, 1899, Canad. Entom., XXXI, p. 215.)

The genera *Crossocerus* and *Pemphilis* are very closely related to, but quite discrete from, each other. Yet so diverse are the characters displayed by the component species and subgenera of each, that the shape of the ocellar triangle is the only entirely reliable feature which will separate the two genera. In *Crossocerus*, the ocelli are invariably arranged in a high equilateral triangle, whereas in *Pemphilis* the ocelli are placed in the form of a low isosceles triangle or curved line. Additionally, the propodeum of *Crossocerus* is fulgid, generally rather finely sculptured and usually provided with a more or less distinct enclosure on the dorsal face; furthermore,

the males seldom have a tibial shield on the fore legs, and the antennae are ordinarily simple, unmodified, and, save in a few species, with distinct fringes of hair beneath. Conversely in *Pemphilis*, the propodeum is either coarsely sculptured, areolate, or coriaceous, with the enclosure of the dorsal face, when such is delimited, opaque; moreover, the males frequently have a large tibial shield on the fore legs, and the antennae are often more or less modified.

The genus *Crossocerus*, as here understood, is approximately equivalent to the "Artengruppe: *Crossocerus*" of Kohl.[1]

Generic Features.—Small to medium sized, more or less fulgid, finely punctate forms. Head subquadrate to subrectangular in both anterior and dorsal aspects. Eyes naked, more coarsely facetted anteriorly than posteriorly; inner orbits strongly convergent below toward clypeus and antennal sockets; malar space wanting. Front usually narrow and more or less shallowly concave between lower inner orbits, but never with a marginate scapal sinus; upper horizontal portion of front generally on same level as vertex and usually bisected anteriorly by a furrow running forward from median ocellus; supra-orbital foveae present or absent; ocelli always situated in a high equilateral triangle; occipital carina well developed or not, but never very strongly flanged and foveolate, nor a complete circle in extent, nor attaining hypostomal carinule, but in some forms terminating below in a spine or dentoid process. Antennae always distinctly thirteen-segmented in males and twelve-segmented in females, situated low on face on dorsal margin of clypeus, the sockets contiguous to each other and to nearest lower inner eye orbit; scapes straight, more or less cylindrical, ecarinate; flagellum generally simple in both sexes, in males usually with a fringe of white hair below. Clypeus variable; usually with a more or less produced median lobe. Maxillary palpi always with six segments and labial palpi with four segments. Mandibles with apices simple, bifid, or tridentate; lower margins entire.

Thorax generally finely punctate throughout. Pronotum short, transverse. Mesonotum, scutellum and postscutellum simple; axillae small to moderate in size, always immarginate. Mesopleura with prepectus sharply margined anteriorly; episternal suture always distinct, and mesopleural pit usually so; episternauli, mesopleurauli, hypersternauli, and sternauli always absent; with or without a tubercle before middle coxae but never with a vertical carina there. Mesosternum rounded, ecarinate anteriorly. Propodeum generally finely sculptured, more or less fulgid, and usually with a more or less distinct enclosure on dorsal face; lateral carinae generally present.

Fore wing with marginal cell elongate, squarely truncate at apex; cubital vein with second abscissa subequal to first abscissa, at least always dis-

[1] Ann. K. K. Naturhist. Hofmus. Wien, XXIX, p. 193, (1915).

tinctly longer than transverse cubital vein. Hind wings with anal lobe distinct, variable in length.

Legs modified or simple. Both sexes generally with a calcar on middle tibiae.

Abdomen sessile to petiolate; maculate or immaculate; impunctate to finely punctate. Tergites with basal acarid chambers, and folded under roundly and imbricate with the convex sternites. Males rarely, females always with a pygidial area on last tergite.

Ethology.—The species of *Crossocerus* are either terricolous or xylicolous. The shape of the female pygidium is generally an excellent criterion for determining the nesting habits of the various forms. Those groups such as *Hoplocrabro* and *Crossocerus* in the restricted sense, in which the female pygidium is broad, flat, trigonal and more or less coarsely punctate, construct burrows in the ground, whereas subgenera such as *Blepharipus*, *Ablepharipus* and *Stictoptila*, which have the pygidium strongly narrowed and more or less excavate apically, nest in old rotten logs and stumps or in the pithy stems of such plants as elders. The pygidia of *Cuphopterus* and *Acanthocrabro* are border line cases: the pygidia of both are flat and trigonal but in each case the lateral margins are slightly incurved and the disc more or less nitidous. Diptera are the usual prey of the majority of the species, but some forms provision their nests with Hemiptera, and a few occasionally resort to caddis flies, small moths, or even mayflies or sawflies.

Distribution.—The genus *Crossocerus* is predominantly Holarctic in distribution, but various groups have representatives in the Neotropical, Oriental and Ethiopian Regions. No forms are yet known from the Australian Region.

Subgenera.—The genus *Crossocerus* is divisible into a great number of natural groups, many of which are so distinctive that they have long since been named. But whether all of these are of sufficient value to be regarded as valid subgenera is a troublesome question, and largely a matter of individual opinion. A number are still known only from one sex; consequently, any proposed classification at present must naturally be inchoate. Since, however, these various groups may be arranged in rather definite morphological, ethological and biogeographical patterns, I shall provisionally accord most of them subgeneric rank until the data are more complete.

Two major groups within the genus are immediately evident: first, that comprising the subgenera *Hoplocrabro*, *Yuchiha*, *Synorhopalum* and *Crossocerus*, all of which have the female pygidium broad, flat, trigonal and more or less coarsely punctate; and secondly, the subgenera *Ablepharipus*, *Epicrossocerus*, *Apocrabro*, *Blepharipus*, *Cuphopterus*, *Nothocrabro*, *Acanthocrabro*, and *Stictoptila* in which the pygidium is strongly narrowed and more or less excavate apically, or if not markedly so, then the lateral margins

are at least slightly incurved and the disc nitidous. The first assemblage are fossorial terricolous forms and are named here the *Chthonocrossocerotes;*[2] whereas the latter complex, to which the name *Dryocrossocerotes*[2] is here applied, are all xylicolous or rubicolous species. Though there cannot be the slightest doubt that a fracture along such lines represents a cleavage of major importance, a detailed and critical analysis of representative forms of the various subgenera indicates that a more natural grouping may be effected by basing the primary divisions of *Crossocerus* upon the character of the mandibular apices. Four interestingly graduated series are the result. The second or Crossocerus Series, composed of terricolous forms which have the mandibular apices of both sexes bidentate, probably represents the primitive or generalized *Crossocerus* type. The first and third groups (the Hoplocrabo and Blepharipus Series respectively) are obviously derivatives of the second; and the fourth group (Stictoptila Series) is without question a derivative of the Acanthocrabroid stock of the third group.

ANALYTICAL CONSPECTUS OF THE SUBGENERA OF CROSSOCERUS

* CHTHONOCROSSOCEROTES: *Terricolous, fossorial forms. Females with a broad, flat, coarsely punctate, trigonal pygidial area.*

1. Mandibular apices of females simple, of males bifid; inner margins edentate. Abdomen sessile; males with last tergite elongate trigonal, without a pygidial area, but at least somewhat more distinctly punctate than preceding tergite, and with ultimate abdominal tergites and sternites simple and unmodified. Mesopleura without a tubercle before middle coxae. Hind wing with anal lobe as long as submedian cell.
   a. Clypeal lobe quadridentate. Abdomen black maculated with yellow, or immaculate black or red. Occipital carina terminating ventrally in distinct spine or tooth. Males with antennal flagellum fringed beneath with white hair. (Large Holarctic forms) ..... *Hoplocrabro* Thomson
   aa. Clypeal lobe more or less truncate. Abdomen immaculate black. Occipital carina not terminating below in a distinct spine or tooth. Males with antennal flagellum glabrous beneath. (Smaller Nearctic and Oriental forms) ..... *Yuchiha* new subgenus
2. Mandibular apices of both sexes bidentate or bifid; inner margins usually edentate. Abdomen immaculate black or red; generally sessile; occasionally petiolate, or the first segment nodose; males with the ultimate tergites and tergites generally simple and unmodified.
   a. Males generally with ultimate abdominal tergite short, transverse, distinctly broader than long, and more distinctly punctate than preceding tergite.
      b. Abdomen petiolate, with first segment strongly nodose at apex. Males unknown. (Nearctic forms) ..... *Synorhopalum* Ashmead
      bb. Abdomen sessile or subsessile, the first segment not petiolate and never nodose at apex. (Widespread) ..... *Crossocerus* Lepeletier & Brullé
         c. Males without a pygidial area ..... Section *Crossocerus* sens. str.
         cc. Males with a pygidial area ..... Section *Stenocrabro* Ashmead

** DRYOCROSSOCEROTES: *Xylicolous forms. Females with pygidial area usually strongly narrowed and excavate apically; rarely flat, subtrigonal and with lateral margins only weakly sinuate, but in such case the disc is nitidous.*

aa. Males with ultimate abdominal tergite more or less trigonal, as long as broad, and not appreciably more coarsely punctate than preceding tergite.
   b. Abdomen sessile. Hind wing with anal lobe longer than submedian cell. Occipital carina simple, not terminating below in a spine or tooth.

[2] These are group names and have no validity in generic nomenclature.

c. Propodeum with well developed lateral carinae and dorsally with a more or less well developed trigonal enclosure. Hind tibiae clavate. Mesopleura with a tubercle before middle coxae. Mandibles with a medial tooth on inner margins. Females with pygidial area trefoil-shaped. (Old World forms) ..... *Ablepharipus* Perkins

cc. Propodeum without lateral carinae and dorsally without a distinct and well defined trigonal enclosure. Hind tibiae simple, elongate-obterete. Mesopleura without a tubercle before middle coxae. Mandibles edentate on inner margins. Females with pygidial area not trefoil-shaped. Male unknown. (Nearctic forms) ..... *Epicrossocerus* Ashmead

bb. Abdomen petiolate, the first segment elongate, slender, petioliform and two and a half to three times as long as wide at apex. Hind wings with anal lobe shorter than submedian cell. Occipital carina terminating below in a more or less well developed tooth. (Oriental forms) ..... *Apocrabro* new subgenus

3. Mandibular apices tridentate in females, bidentate or bifid in males. Males with ultimate abdominal tergite more or less trigonal, as long as broad, and not appreciably more coarsely punctate than preceding tergite.

a. Mandibles edentate on inner margins. Abdomen sessile, immaculate black. Females with pygidial area strongly narrowed and excavate apically, males with ultimate abdominal tergites and sternites either simple or modified. Mesopleura with or without a tubercle before middle coxae. (Widespread but chiefly Holarctic forms) ..... *Blepharipus* Lepeletier & Brullé

aa. Mandibles with a more or less well developed tooth medially on inner margins. Abdomen black, generally maculated with yellow; in males, with seventh sternite keeled, carinate or tuberculate discally, the ultimate tergite with inflexed ventral processes. Males with fore tarsi sinuate or distorted.

b. Mesopleura without a tubercle before middle coxae. Males with fore femora edentate behind.

c. Abdomen subsessile, the first segment distinctly longer than broad at apex; generally black maculated with yellow, occasionally immaculate black or red. Females with a flat, subtrigonal pygidial area, the lateral margins weakly sinuate, the disc more or less nitidous. Males with hind coxae strongly dentate below at base; fore metatarsi sinuate; fore femora more or less flattened beneath and carinate posteriorly; middle tibiae with a sharp, sinuous carina lengthwise on outer faces. Supra-orbital foveae distinct in females; indistinct in males. (Old World forms) ..... *Cuphopterus* A. Morawitz

cc. Abdomen sessile, the first segment distinctly shorter than its apical width; black maculated with yellow. Females with pygdial area strongly narrowed and excavate apically. Males with hind coxae edentate below; fore metatarsi more or less spirally distorted; neither fore femora nor middle tibiae carinate. Supra-orbital foveae distinct in both sexes. Fore wings with fuscous spots. (Nearctic forms) ..... *Nothocrabro* new subgenus

bb. Mesopleura with a tubercle before middle coxae. Abdomen sessile, with first segment short, not or scarcely longer than its apical width; black maculated with yellow. Males with fore femora dentate posteriorly; fore metatarsi sinuate; middle tibiae ecarinate on outer faces; hind coxae edentate below. Females with pygidial area flat, subtrigonal, the lateral margins moderately narrowed toward apex, the disc more or less nitidous. Supra-orbital foveae distinct in both sexes. Fore wings with more or less distinct fuscous spots. (Old World forms) ..... *Acanthocrabro* Perkins

4. Mandibular apices tridentate in both sexes and inner margins dentate medially. Mesopleura with a tubercle before middle coxae. Abdomen sessile, the first segment shorter than its apical width; black maculated with yellow. Females with pygidium strongly narrowed and excavate apically. Males with seventh abdominal sternite keeled, carinate or tuberculate discally; and seventh tergite more or less trigonal, as long as broad, not appreciably more coarsely punctate than preceding tergite, and with inflexed ventral processes; fore metatarsi spirally distorted; fore femora edentate posteriorly; middle tibiae ecarinate; hind coxae edentate. Supra-orbital foveae distinct in females, indistinct in males. Fore wings with fuscous spots. (Nearctic forms) ..... *Stictoptila* new subgenus

Subgenus HOPLOCRABRO Thomson

Crabro (*Hoplocrabro*) Thomson, Hymen. Scand., III, p. 277, (1874).—Berland, Faune de France, X, p. 186, (1925).—Schmiedeknecht, Hymen. N. u. Mitteleurop., Zw. Aufl., p. 648, (1930).
Crabro (Haupt-Artengruppe *Crabro:* Artengruppe *Hoplocrabro*) Kohl, Ann. K. K. Naturhist. Hofmus. Wien, XI, p. 492, (1896).
Crabro (Artengruppe *Crossocerus:* Untergruppe *Hoplocrabro*) Kohl, Ann. K. K. Naturhist. Hofmus. Wien, XXIX, pp. 195, 219, 398, (1915).—Pate, Amer. Ent. Soc. Mem. no. 9, p. 32, (1937).
Hoplocrabro Ashmead, Canad. Entom., XXXI, p. 216, (1899).—Richards, Gen. Names Brit. Ins., pt. 5, Hymen. Acul., pp. 106, 133, (1937).
Crossocerus (*Hoplocrabro*) Pate, Canad. Entom., LXXIV, pp. 177–185, (1942). (Review of taxonomy and biology.)

GENOTYPE: *Crabro 4-maculatus* Fabricius, 1793 [=*Crossocerus* (*Hoplocrabro*) *4-maculatus* (Fabricius)]. (Monobasic.)

The subgenus *Hoplocrabro* is a small and compact entity closely related to *Yuchiha*. The dentate gular region and other features given in the foregoing tabular conspectus readily differentiate it from that subgenus.

I have recently presented elsewhere a review of the taxonomy and biology of the component species.

Ethology.—The species of *Hoplocrabro* are fossorial forms which excavate their nests in sandy ground. The burrows are provisioned generally with a great variety of small flies (Trichoceridae, Tipulidae, Anisopodidae, Culicidae, Chironomidae, Mycetophilidae, Rhagionidae, Dolichopodidae, Empididae, Helomyzidae, Sapromyzidae, Pallopteridae, Anthomyidae), occasionally with Trichoptera (Phryganeidae, Hydropsychidae), and rarely with small moths (Olethreutidae).

Distribution.—The subgenus *Hoplocrabro* is a small entity confined largely, if not wholly, to the Holarctic Region.

Yuchiha[3] new subgenus

As in *Hoplocrabro*, the anal lobe of the hind wing of *Yuchiha* is as long as the submedian cell and the mandibles of the female are falcate and simple apically while those of the male are bifid at apex. These two features readily differentiate both *Yuchiha* and *Hoplocrabro* from all the other subgenera of *Crossocerus*. The species of *Yuchiha*, however, are much smaller; only approximately one-half the size of those included *Hoplocrabro*. Furthermore, the clypeal lobe is more or less truncate, or at best tricrenulate, in the present entity, whereas in *Hoplocrabro* it is typically quadridentate. In addition, the median groove bisecting the mesosternum is carinulate for its entire length in *Yuchiha;* in *Hoplocrabro* the carinule is evident for only two-thirds the length of the groove. Finally, the males of *Hoplocrabro* have the antennal flagellum furnished beneath with a distinct fringe of hairs; these are absent in *Yuchiha*. The females of *Yuchiha* bear

[3] After the Yuchiha (*seu* Yuchi, *seu* Uchee) Indians who formerly inhabited central and northern Georgia.

a superficial resemblance to those of *Lindenius*, but may be readily distinguished from the members of that genus by the edentate inner mandibular margins and the position of the ocelli which in the present entity are arranged in an equilateral triangle.

Diagnostic Features.—Small, more or less fulgid, finely punctate forms. Head subquadrate in anterior aspect, broadly subrectangular in dorsal aspect. Front simple, unarmed, and on anterior vertical aspect between inner orbits narrow, somewhat concave discally and with a glabrous, more or less nitidous, but immarginate scapal sinus provided medially above with a small but distinct pit; upper horizontal portion of front on same plane as vertex, bisected anteriorly by a weak furrow running forward from median ocellus. Vertex flat; without supra-orbital foveae; postocellar line subequal to or shorter than ocellocular distance. Temples moderate, ecarinate, and unarmed in both sexes; occipital carina moderate, not terminating below in a spine in either sex. Antennae with scapes straight, cylindrical, ecarinate; flagellum simple in both sexes, in males without fringes of hair beneath. Clypeus short, transverse, gently convex to very weakly tectate discally; clypeal lobe more or less truncate apically, at most tricrenulate. Mandibles with apices simple in females, bifid in males; both sexes with inner margins edentate. Females without a psammophore.

Thorax finely punctate throughout. Pronotum short, transverse, somewhat depressed below level of mesonotum; flat dorsally but not transversely carinate anteriorly, the lateral angles bluntly rounded, posterior margin impressed. Mesonotum, scutellum and postscutellum simple; axillae small, immarginate. Mesopleura finely punctate; prepectus sharply margined anteriorly; episternal suture and mesopleural pit distinct; without either a tubercle or vertical carina before middle coxae; mesosternum rounded, not transversely carinate anteriorly. Propodeum not coarsely sculptured; dorsal face with a trigonal or semicircular enclosure defined by a foveolate groove; lateral carinae present.

Legs relatively simple. Tarsi neither flattened nor otherwise modified in either sex; females without a distinct pecten. Middle tibiae with a distinct apical calcar in both sexes.

Fore wings with marginal cell twice as long as wide and broadly, squarely truncate at apex, with a large trigonal appendiculate cell there; radial vein with first abscissa two-thirds the length of second; transverse cubital vein oblique, inclivous, straight, about three-fourths the length of second abscissa of cubitus which is five-sixths to six-sevenths the length of first abscissa. Hind wing with anal lobe as long as submedian cell.

Abdomen finely punctate at most; sessile, fusiform, immaculate black; first segment about as long as wide at apex and usually perfectly sessile with second. Tergites with basal acarid chambers. Males without a pygidial area on ultimate tergite which is more coarsely punctate than penult

tergite; neither tergite with inflexed ventral processes; apical sternites simple, without tubercles or processes; hypopygium simple, flat. Females with a broad, flat trigonal pygidium.

GENOTYPE: *Crossocerus* (*Yuchiha*) *xanthochilos* new species.

Distribution.—The distribution of the subgenus *Yuchiha* is markedly discontinuous. Three species are known at present: one, *xanthochilos*, from north-central Georgia; another, *phaeochilos*, from west-central Mexico; and a third, *melanochilos*, from the island of Formosa. In the main, this peculiar distributional pattern is one which has many parallels in other groups of animals and plants. Entities displaying this type of distribution are usually Pliocene relicts: this is probably true in the present instance.

Ethology.—From the sand grains lodged in the foveae on the propodeum and other portions of the thorax of the Formosan *melanochilos*, I infer this species nests in sandy soil. The broad, flat, trigonal female pygidium of all species of *Yuchiha* lends support to this thesis. The sting of the female *melanochilos* is strongly recurved, and this is presumptive evidence that the prey, probably Dipterous, is carried impaled on the sting, much as it is in *Pemphilis* (*Paranothyreus*) *cingulatus*, or in the various species of *Oxybelus*.

Crossocerus (Yuchiha) xanthochilos new species

The Nearctic form *xanthochilos* is readily differentiated from the Formosan species *melanochilos* by its yellow clypeus and legs, and the relatively shorter antennal scapes and clypeus, the last of which is gently tumid rather than weakly tectate discally. Furthermore, in *xanthochilos* the postocellar distance is but seven-tenths the ocellocular line, whereas in *melanochilos* the ocellocular and postocellar distances are subequal. The features distinguishing *xanthochilos* from the following Mexican form *phaeochilos* are presented in the introductory discussion under that species.

Type.—♀; Oglethorpe, Macon County, Georgia. July 1, 1910. (J. C. Bradley.)

Female. 4 mm. long. Black; the following deep stramineous: palpi, mandibles except red apices, clypeus, scapes, pedicel beneath, pronotum dorsally, pronotal tubercles, anterior two-thirds of scutellum, all coxae beneath, all trochanters and tarsi entirely, fore femora at apex, fore and middle tibiae on outer faces, and hind tibiae at base. The following flavofulvous: pedicel above, flagellum, tegulae, axillary sclerites, all femora and tibiae aside from yellow maculation, abdominal venter, and entire last abdominal segment. Wings clear hyaline, iridescent; veins and stigma fulvous.

Head more or less fulgid; clypeus and front along inner orbits with appressed, silvery, sericeous pile; vertex thinly clad with suberect, inconspicuous, light, puberulent pubescence; temples with a moderate clothing

of decumbent short silvery hairs. Vertex and upper front with a microscopically fine cancellate sculpture upon which is superposed a series of moderately fine, close, setigerous punctures, bisected anteriorly by a very faint impression running forward from median ocellus; postocellar line about seven-tenths (.71) the ocellocular distance; temples fulgid, more finely and sparsely punctate than vertex; occipital carina moderate, finely consute anteriorly. Antennae with scapes straight, cylindrical, ecarinate, a little less than half (.461) the vertical eye length; pedicel obterete, subequal in length to first flagellar article; flagellum reaching about to occiput, simple, finely puberulent, first two segments subequal in length, ultimate article simple, terete, one and a half times the length of penult segment. Clypeus transverse, median length about one-fourth (.23) the vertical eye length; flat and attenuate laterally to merely gently tumid discally; produced medially into a short, broad, subtruncate lobe, the width of which is subequal to the median clypeal length, apical margin of lobe bisinuate and thus obscurely tricrenulate. Mandibles subfalcate; apices simple, acuminate; inner margin edentate.

Thorax fulgid to subopaque; dorsally with a thin vestiture of short, suberect, light hairs; pleura and sterna with a thin clothing of more noticeable, short, decumbent, silvery hair. Pronotum with a weak median notch dorsally. Mesonotum subopaque, with a microscopically fine cancellate sculpture upon which is superposed a series of moderately fine and well separated, setigerous punctures; scutellum flatly tumid, sculptured like mesonotum, anterior margin deeply impressed and consute; postscutellum punctured like scutellum. Mesopleura perfulgid, anteriorly with rather widely separated, setigerous acupuncturation to subnitidous posteriorly; episternal suture strongly foveate; posterior margin finely foveate; metapleura glabrous, nitidous, posterior margins coarsely foveate. Propodeum perfulgid, glabrous; dorsal face with a large obtrapeziform, glabrous, nitidous enclosure defined by a strongly foveate furrow, the anterior margin weakly foveate, and bisected by a very slender and weakly marginate terete foveate furrow which terminates in the weakly marginate, subcuneate discal impression of the posterior face, laterad of which the surface is subglabrous and subnitidous; lateral carinae present and well developed along posterior face but obsolescent above on dorsal face; lateral faces glabrous and nitidous save for a very weak, short, oblique furrow running ventrad from spiracle.

Legs simple; fore tarsi not appreciably flattened and without a distinct pecten. Middle tibiae with one apical calcar; hind tibiae with two calcaria, the longer acuminate and four-fifths the length of hind metatarsi; hind tibiae obterete and moderately spinose on outer faces.

Abdomen fulgid, subfusiform; first segment about as long as its apical width and very weakly and inconspicuously constricted at apex. Tergites

with very fine, widely separated, evenly disposed, setigerous acupunctures; clothed with a very sparse vestiture of silvery to light aeneous, short decumbent hair; ultimate tergite with a flat, equilaterally trigonal pygidium, the disc fulgid and with rather close and regularly disposed coarse punctures, each of which bears a short decumbent setula. Sternites glabrous and nitidous save for a transverse preapical row of short, suberect setulae on second to fifth segments.

This interesting little Georgian species is known only from the unique female described above.

Crossocerus (Yuchiha) phaeochilos new species

The present species is somewhat intermediate between the preceding Georgian form *xanthochilos* and the following Formosan species *melanochilos* but is distinguished from both by its more opaque habitus, the pronounced, though fine, cancellate sculpture on the thorax and vertex, and the much broader clypeal lobe, the wider furrow bisecting the dorsal face of the propodeum, the more sparsely punctate pygidium, and the different ocellocular-postocellar ratio.

Type.—♀; Guadalajara, Jalisco, Mexico. Elevation, 5060 feet. September 18, 1903. (J. F. McClendon.)

Female. 4 mm. long. Black; the following deep stramineous: palpi, mandibles except red apices, scapes anteriorly, pronotum dorsally, pronotal tubercles; anterior two-thirds of scutellum, fore and middle tibiae on outer faces, hind tibiae broadly annulate at base. Dark fulvous: apical half of clypeus, tegulae and axillary sclerites, fore and middle tibiae and femora beneath, all tarsi and tibial calcaria. Abdominal venter light brunneous. Wings clear hyaline, iridescent; veins and stigma brunneous.

Head subfulgid; clypeus and front along inner orbits with appressed, silvery, sericeous pile; vertex thinly clad with suberect, light puberulent pubescence; temples with a moderate clothing of decumbent short silvery hair. Vertex and upper front with a fine cancellate sculpture upon which is superposed a series of moderately fine, close, setigerous punctures, bisected anteriorly by a furrow running forward from median ocellus, the brow of front strongly tumid on each side of furrow; postocellar line five-eighths the length of ocellocular distance; temples fulgid, more finely and sparsely punctate than vertex; occipital carina moderate, finely consute anteriorly. Antennae with scapes almost five-eighths (.615) the vertical eye length; pedicel subcylindrical, four-fifths the length of first flagellar article; flagellum simple, finely puberulent, first two segments subequal in length, ultimate article simple, terete. Clypeus transverse, median length about one-fourth (.23) the vertical eye length; flat and attenuate laterally, to merely gently tumid discally; produced medially into a short, broad, subtruncate lobe, the width of which is one and seven-tenths the median

clypeal length; apical margin of lobe strongly bisinuate and thus tricrenulate. Mandibles stout, subfalcate; apices simple, bluntly acuminate; inner margin edentate.

Thorax more or less subopaque; dorsally with a thin vestiture of short, suberect, light hairs; pleura and sterna with a thin clothing of more noticeable short, decumbent silvery hair. Pronotum with a weak median notch dorsally. Mesonotum opaque, with a strong and distinct, though fine, cancellate sculpture upon which is superposed a series of moderately fine, well separated, setigerous punctures; scutellum and postscutellum simple, sculptured like mesonotum, the former with a foveolate groove along anterior margin. Mesopleura fulgid, with rather widely separated, setigerous acupuncturation throughout; episternal suture coarsely foveolate; posterior margin foveate; metapleura glabrous, nitidous, posterior margin coarsely foveolate. Propodeum fulgid, glabrous; dorsal face with a large, subrectangular, nitidous enclosure defined posteriorly by a strongly foveate groove, the anterior margin strongly foveate, and bisected by a wide, strongly marginate, foveate furrow which terminates in the subcuneate discal impression of posterior face, laterad of which surface is nitidous; lateral carinae well developed along posterior face but obsolescent dorsally; lateral faces nitidous.

Legs simple, in general as in *xanthochilos* except longer hind tibial calcar is but two-thirds the length of hind metatarsi.

Abdomen more or less fulgid; in general as in *xanthochilos* except disc of pygidium is very sparsely, though coarsely, punctate.

Only the unique female of this Mexican species is known.

Crossocerus (Yuchiha) melanochilos new species

The black clypeus and femora, the subequal postocellar and ocellocular distances, and the relatively long antennal scapes and clypeus, the latter of which is weakly tectate discally, distinguish the present Formosan species from both the preceding North American forms.

Type.—♀; Taihoku, Formosa. Elevation, 20 meters. April, 1912.

Female. 4.5 mm. long. Black; the following deep stramineous: palpi, mandibles save red apices, scapes anteriorly, pronotum dorsally, pronotal tubercles, scutellum, fore femora with a small spot at apex, fore tibiae entirely except for brunneous streak on inner faces, middle tibiae on outer basal half, and hind tibiae broadly annulate at base. Fulvous: scapes posteriorly, and all tarsi entirely. Tegulae and axillary sclerites light brunneous. Wings clear hyaline, iridescent; stigma and veins light brunneous.

Head subfulgid; clypeus with appressed, silvery sericeous pile; vertex thinly clad with suberect, inconspicuous, light aeneous, puberulent pubescence; temples with a sparse vestiture of decumbent short silvery hair. Vertex and upper front with moderately fine, close, setigerous punctures,

bisected anteriorly by a faint impression running forward from median ocellus; postocellar line subequal to ocellocular distance; temples fulgid, more finely and sparsely punctate than vertex; occipital carina moderate. Antennae with scapes two-thirds the vertical eye length; pedicel obterete, subequal in length to first flagellar article; flagellum simple, finely puberulent, first two segments subequal in length, ultimate article simple, terete, five-thirds the length of penult segment. Clypeus transverse, median length three-tenths the vertical eye length; flat and attenuate laterally to weakly tectate discally, produced medially into a short, broad, subtruncate lobe, the width of which is subequal to median clypeal length, apical margin of lobe bisinuate, and thus weakly tricrenulate. Mandibles subfalcate; apices simple, bluntly acute; inner margin edentate.

Thorax more or less fulgid; dorsally with a thin vestiture of short, suberect, light aeneous hair; pleura and sterna with a sparse clothing of short, decumbent silvery hair. Mesonotum with moderately fine and close setigerous puncturation throughout but no basic cancellate sculpture; scutellum and postscutellum simple, punctured like mesonotum, the former with a foveolate groove along anterior margin. Mesopleura fulgid, with rather widely separated, setigerous acupuncturation throughout; episternal suture strongly foveate; hind margin foveolate; metapleura subglabrous, subnitidous, hind margin strongly foveolate. Propodeum perfulgid; dorsal face with a large semicircular, glabrous, nitidous enclosure defined posteriorly by a strongly foveate groove, the anterior margin foveate, and bisected by a slender, marginate, infundibuliform furrow which terminates in the subcuneate discal impression of posterior face, laterad of which surface is sparsely acupunctate, each puncture bearing a short, suberect light hair, and in valvular region with a few sinuate horizontal carinules; lateral carinae well developed along posterior face but obsolescent above; laterad faces glabrous and nitidous save for a short oblique furrow running ventrad from the spiracle, and several subparallel horizontal carinules along lower margin just above hind coxae.

Legs simple, unmodified; fore tarsi without a distinct pecten. Hind tibiae obterete, moderately spinose on outer faces; the longer calcar aciculate-acuminate, four-fifths the length of hind metatarsi.

Abdomen fulgid, subfusiform; first segment about as long as its apical width and very weakly, inconspicuously constricted at apex. Tergites with fine, widely separated, evenly disposed, setigerous acupunctures; with a very sparse vestiture of silvery to light aeneous, short decumbent hair; ultimate tergite with a flat, subequilaterally trigonal pygidium, the disc perfulgid, with a few scattered, coarse punctures, each bearing a short decumbent setula. Sternites glabrous, nitidous, save for a transverse subapical row of short erect setulae on second to fifth segments.

Allotype.—♂; Taihoku, Formosa. Elevation, 20 meters. April, 1912.

Male. 4.5 mm. long. Agrees with the female (type) except in following details.

Livery the same except pronotum has only two yellow spots dorsally; scutellum black; maculation of legs not as extensive; tarsi black.

Head with vertex more finely punctate; scape about five-eighths (.636) the vertical eye length; flagellum simple, without hair fringes beneath, all segments simple, unmodified. Clypeus about one-fourth (.272) vertical eye length. Mandibles slender; apices distinctly bidentate.

All legs simple unmodified. Longer hind tibial calcar three-fourths the length of hind metatarsi.

Abdomen with all sternites simple, the apical ones without tubercles, processes or otherwise modified, all posterior margins entire, truncate. Ultimate tergite without a pygidial area, the disc with a few scattered, coarse punctures which are more distinct than those of penult tergite; lateral margins of last tergite briefly inflexed at sides but without processes projecting toward midventral line.

Specimens Examined.—In addition to the types, I have examined an additional pair of topotypic, equidatic paratypes which agree with the types in all essential features of livery and structural detail.

Subgenus Crossocerus Lepeletier & Brullé

Crossocerus Lepeletier & Brullé, Ann. Soc. Ent. France, III, p. 763, (1835); [in part].—Ashmead, Canad. Entom., XXXI, pp. 216–217, (1899).—Perkins, Trans. Ent. Soc. London, pp. 390, 394, (1913).—Hamm & Richards, Trans. Ent. Soc. London, pp. 314, 326, (1926).—Richards, Gen. Names Brit. Ins., pt. 5, Hymen. Acul., pp. 106, 132, (1937).

Crabro (*Crossocerus*) Wesmael, Bull. Acad. R. Sci. Belg., XIX, p. 594, (1852); [in part].—Morawitz, Bull. Acad. Sci. St. Petersbourg, VII, p. 456, (1864).—Thomson, Hymen. Scand., III, p. 272, (1874).

Crabro (Haupt-Artengruppe *Crabro*: Artengruppe *Crossocerus*) Kohl, Ann. K. K. Naturhist. Hofmus. Wien, XI, p. 491, (1896).

Crabro (15. Group *minimus*) Fox, Trans. Amer. Ent. Soc., XXII, p. 187, (1895).

Crabro (18. Group *planipes*) Fox, Trans. Amer. Ent. Soc., XXII, p. 193, (1895); [in part].

Stenocrabro Ashmead, Canad. Entom., XXXI, p. 216, (1899); [in part].

Crossocerus (*Stenocrabro*) Perkins, Trans. Ent. Soc. London, pp. 390, 394, (1913).

Crabro (Artengruppe *Crossocerus:* Untergruppe *Crossocerus*) Kohl, Ann. K. K. Naturhist. Hofmus. Wien, XXIX, pp. 195, 247–271, (1915).

Genotype: *Crabro scutatus* Fabricius, 1787 [=*Sphex palmaria* Schreber, 1784=*Sphex palmipes* Linnaeus, 1767=*Crossocerus* (*Crossocerus*) *palmipes* (Linne)]. (By designation of Ashmead, 1899, Canad. Entom., XXXI, p. 215.)

These small black forms are distinguished by their perfectly sessile abdomen, which in the females is furnished with a flat trigonal pygidium, while the males have the ultimate tergite short, broad, transverse and coarsely punctate. In addition, the mandibular apices are bidentate and the inner margins edentate in both sexes. As here understood, *Crossocerus* is about the equivalent of the complex which Kohl in 1915 defined as the Untergruppe *Crossocerus*.

The forms comprising the subgenus *Crossocerus* are quite varied in their structural features, particularly those of the male sex, and, when a thorough review of all the component species is made, the complex may prove to be separable into two or more distinct subgenera. For those species which in the male sex have a pygidial area delimited on the ultimate abdominal tergite and the fore legs relatively simple except that the fore tarsi may be flattened or more or less expanded, Ashmead's name *Stenocrabro* is applicable. But I have been unable to find any wholly satisfactory character for separating the females of this group from those of *Crossocerus* in the most restricted sense as typified by *C. palmipes* (L.) Consequently, at the present time, I regard *Stenocrabro* as merely a section of the subgenus *Crossocerus*.

Ethology.—The species of *Crossocerus* generally construct their nests in sandy ground, although occasionally they will utilize cracks or crannies in old walls or even abandoned holes made in old posts or tree trunks by wood-boring beetles. The cells are provisioned with a varied assortment of Diptera (Tipulidae, Chironomidae, Cecidomyidae, Therevidae, Syrphidae, Phoridae, Pipunculidae, Platypezidae, Dolichopodidae, Empididae, Chamaemyidae, Psilidae, Chloropidae, Drosophilidae, Sapromyzidae, Agromyzidae, Ephydridae, Anthomyidae).

Distribution.—The subgenus *Crossocerus* is principally Holarctic in distribution.

Two Nearctic members of the present complex have their names preoccupied and the present opportunity is taken to rename them.

Crossocerus (Crossocerus) chromatipus new name

Crabro pictipes Fox, Trans. Amer. Ent. Soc., XXII, p. 187, (1895). (Not Herrich-Schaeffer, 1841, Faun. Insect. Germ., Fasc. 181, tab. 5.)

Crossocerus (Crossocerus) pelas new name

Crabro propinquus Fox, Trans. Amer. Ent. Soc., XXII, p. 189, (1895). (Not Shuckard, 1837, Essay Indig. Foss. Hymen., p. 168.)

Subgenus SYNORHOPALUM Ashmead

Crabro (21. Group *decorus*) Fox, Trans. Amer. Ent. Soc., XXII, p. 199, (1895).
Synorhopalum Ashmead, Canad. Entom., XXXI, p. 218, (1899).
Rhopalum H. S. Smith, Univ. Nebraska Stud., VIII, p. 395, (1908).—Mickel, Univ. Nebraska Stud., XVII, p. 371, (1918). (Not Kirby, 1829.)

GENOTYPE: *Crabro decorus* Fox, 1895 [=*Crossocerus* (*Synorhopalum*) *decorus* (Fox)]. (By original designation of Ashmead.)

The petiolate abdomen, the first segment of which is strongly nodose at apex and separated from the remainder by a strong constriction, causes *Synorhopalum* to superficially resemble *Euplilis*. Indeed, ever since Ashmead placed it in his subfamily Rhopalinae, subsequent authors have treated *Synorhopalum* as merely a synonym of *Rhopalum* (i. e. *Euplilis*).

But the six-segmented maxillary and four-segmented labial palpi and the sharply carinate anterior margin of the prepectus are more than sufficient to exclude it from *Euplilis*. Instead, these and all other basic characters attest its close relationship to the nominate group of *Crossocerus*. Unfortunately the male sex of *Synorhopalum* is still unknown, but until it is, the distinctive structure of the abdomen will serve to immediately distinguish it from its related subgenera.

Ethology.—The species of *Synorhopalum* are terricolous forms. At Mesilla, New Mexico, Cockerell[4] found *decorus* burrowing in a sand bank, and H. S. Smith[5] observed a number of females of the same species nesting in a clay butte at Glen, in the badlands of northwestern Nebraska. There are no records of what the species of *Synorhopalum* prey upon, but in all probability it will eventually be found to be Diptera.

Distribution.—The subgenus *Synorhopalum* is a precinctive Nearctic entity, ranging throughout the xeric areas of western North America from western Nebraska and southern New Mexico westward to southern California.

Subgenus Ablepharipus Perkins

Crossocerus Lepeletier & Brullé, Ann. Soc. Ent. France, III, p. 786, (1835); [in part].
Crabro (*Coelocrabro*) Thomson, Hymen. Scand., III, p. 270, (1874); [in part].—Berland, Faune de France, X, p. 186, (1925); [in part].—Schmiedeknecht, Hymen. N. u. Mitteleurop., Zw. Aufl., p. 649 (1630).
Crabro (Haupt-Artengruppe *Crabro:* Artengruppe *Coelocrabro:* Untergruppe *Crabro gonager* Lep., *podagricus* v. d. L.) Kohl, Ann. K. K. Naturhist. Hofmus. Wien, XI, p. 491, (1896).
Crabro (Artengruppe *Crabro:* Untergruppe *Coelocrabro*) Kohl, Ann. K. K. Naturhist. Hofmus. Wien, XXIX, pp. 195, 240–242, (1915); [in part].
Crabro (*Crossocerus Blepharipus*) Pate, Amer. Ent. Soc. Mem. no. 9, p. 5, (1937); [in part].
Ablepharipus Perkins, Trans. Ent. Soc. London, p. 390, (1913).—Hamm & Richards, Trans. Ent. Soc. London, p. 314, (1926).—Richards, Gen. Names Brit. Ins., pt. 5, Hymen. Acul., pp. 106, 132, (1937).

Genotype: *Crabro podagricus* Van der Linden, 1829 [=*Crossocerus* (*Ablepharipus*) *podagricus* (Van der Linden)]. (Monobasic.)

This complex is rather closely related to Ashmead's *Epicrossocerus*, but the strongly clavate hind tibiae, the relatively well developed lateral carinae and dorsal enclosure of the propodeum, the dentate inner mandibular margins, and the trefoil-shaped female pygidium distinguish *Ablepharipus* from that subgenus. Kohl and most continental European authors have regarded *Ablepharipus* as merely a synonym or section of *Coelocrabro* (i. e. *Blepharipus* as understood here), but the markedly different mandibular dentition and curious pygidial conformation readily separate it from that complex.

Ethology.—The species of *Ablepharipus* are xylicolous forms, generally nesting in the abandoned burrows of wood-boring beetles. The cells are

[4] Proc. Davenport Acad. Nat. Sci., VII, p. 148, (1898).
[5] Univ. Nebraska Stud., VIII, p. 395, (1908).

provisioned with various small Nematocera and Acalyptrate Diptera (Chironomidae, Ceratopogonidae, Scatopsidae, Chloropidae).[6]

Distribution.—The subgenus *Ablepharipus* is a small complex confined to the Old World, with representatives in the Palaearctic and Oriental Regions.

Subgenus EPICROSSOCERUS Ashmead

Crabro (17. Group *insolens*) Fox, Trans. Amer. Ent. Soc., XXII, p. 192, (1895).
Epicrossocerus Ashmead, Canad. Entom., XXXI, p. 215, (1899).
Crabro (*Epicrossocerus*) Rohwer, Ent. News, XX, p. 153, (1909).

GENOTYPE: *Crabro insolens* Fox 1895 [=*Crossocerus* (*Epicrosssocerus*) *insolens* (Fox)]. (By original designation of Ashmead.)

The small microscopically sculptured forms referable to *Epicrossocerus* are most closely related to the Old World group *Ablepharipus*. But the large cubical head, the edentate inner mandibular margins, the simple obterete hind tibiae, the short, simple, rounded propodeum devoid of lateral carinae and a dorsal enclosure, and the differently shaped female pygidium, readily differentiate *Epicrossocerus* from that subgenus.

Ashmead established *Epicrossocerus* as a genus for the reception of *Crabro insolens* Fox, and in error gave the sex as male. But, as Rohwer subsequently indicated, the male sex of *insolens*, as well as the other species later referred to it (i. e. *universitatis* and *raui*), was and still remains unknown. The females, however, exhibit a number of features sufficiently distinctive to warrant this group being accorded subgeneric status. Until the males of *Epicrossocerus* are definitely known and described, the features given in the foregoing tabular conspectus of the subgenera will serve to characterize this peculiar little entity.

Ethology.—The biology of this group is unknown. But inasmuch as the pygidium of the females is strongly narrowed and excavate apically, the species of *Epicrossocerus* are rubicolous or xylicolous in all probability.

Distribution.—The subgenus *Epicrossocerus* is a small endemic Nearctic complex, the species of which range from the central Mississippi basin area westward to the Rocky Mountain region.

Apocrabro[7] new subgenus

The superficial habitus of the present complex is very similar to that of *Euplilis*, but from that genus *Apocrabro* may be distinguished by its markedly different palpal formula, the sharply margined prepectus, the strong tubercle on the mesopleura before the middle coxae, the well developed gular teeth and lateral propodeal carinae, the simple obterete hind tibiae,

[6] *Cf.* Hamm & Richards, 1926, Trans. Ent. Soc. London, pp. 314, 328. *V. et.:* Goidanich, A.—Reperti biologici e morfologici sul *Crabro* (*Coelocrabro*) *podagricus* Van der Linden. Boll. Lab. Ent. R. Ist. Sup. Agr. Bologna, I, 96–106, (1928).

[7] From *Apo*, after Mt. Apo in Mindanao, +*Crabro*.

and the simple, non-nodose abdominal petiole. The nearest relative of *Apocrabro* is the subgenus *Cuphopterus*, from which the present entity is distinguished by the different mandibular dentition, the well developed gular teeth—somewhat resembling *Hoplocrabro* in this respect, the presence of a large, strong and sharp precoxal tubercle on the mesopleura, the simple unmodified legs, and the well developed lateral propodeal carinae. Furthermore, in *Cuphopterus* the female pygidium is flat and trigonal, whereas in *Apocrabro* it is more or less excavate and strongly narrowed apically. Finally, the males of *Cuphopterus* have the antennal flagellum provided with a distinct fringe of hairs beneath, while the ultimate abdominal tergite is furnished with inflexed ventral processes which overly the strongly tuberculate disc of the corresponding sternite; the males of *Apocrabro* conversely have the antennal flagellum glabrous beneath and the apical abdominal tergites and sternites simple.

Diagnostic Features.—Slender, elongate, fulgid, finely punctate, moderate sized forms. Head broader than the thorax, subquadrate to subrectangular in anterior aspect, subrectangular to subpanduriform in dorsal aspect. Eyes very large, with inner orbits subparallel and very broad below in anterior aspect, and strongly divergent in dorsal aspect. Front very narrow, shallowly concave, glabrous and nitidous but without a marginate scapal sinus on anterior vertical aspect between the lower inner orbits, frequently armed medially below with a spine or tubercle; upper horizontal portion of front broad and bisected by a sharp impression or furrow running forward from median ocellus to anterior face. Vertex flat, simple; supraorbital foveae usually present though sometimes indistinct; ocelli rather large, arranged in an equilateral triangle; occipital carina well developed, particularly below where it terminates abruptly in a distinct tooth or dentoid process, but not appreciably flanged, foveolate, a complete circle in extent or attaining hypostomal carinule; oral fossa transversely subcircular; hypostomal carinule well developed, sometimes flanged, on midventral line furnished with a low rounded protuberance or tooth, and from posterior lateral edges with an arcuate carinule curving forward and terminating in the large inframandibular lobe. Temples moderate, tapering ventrad, simple, ecarinate. Antennae with scapes slender, straight, elongate-cylindrical, ecarinate; pedicel subcylindrical, shorter than first flagellar article; flagellum simple in both sexes, glabrous beneath in males. Clypeus short, transversely sublinear. Maxillary palpi with six segments, labial palpi with four segments. Mandibles rather slender and elongate; apices evenly bidentate in both sexes, lower margins entire; inner margins edentate or practically so. Females without a psammophore.

Thorax narrower than head; more or less fulgid; dorsum and pleura finely punctate at most. Pronotum short, transverse, situated on same level as mesonotum; anterior dorsal margin ecarinate, broadly rounded,

not notched medially but with lateral angles more or less sharply dentate or angulate. Mesonotum simple, without lateral laminae; axillae small, not prominent; suture between mesonotum and scutellum, and scutellum and postscutellum simple, efoveate, but strongly impressed; scutellum and postscutellum simple. Propleura produced at lower outer lateral angles into a stout, sharp tuberculoid process. Mesopleura with prepectus sharply margined anteriorly; with a large, sharp and strong spinoid tubercle before middle coxae; episternal suture distinct and strongly impressed; mesopleural pit small, often indistinct. Mesosternum rounded, ecarinate anteriorly. Propodeum on dorsal face usually either with a semicircular enclosure or separated from posterior face by a transverse carina, occasionally without either; posterior face bisected by a vertical impression; lateral carinae well developed for entire length, simple below.

Legs slender, elongate and simple in both sexes. All tarsi simple, the metatarsi subequal in length to four distal segments combined; ultimate article slender, elongate; pulvilli distinct, moderate in size; females with fore tarsi not flattened, but with a weak pecten of short, stiff spines. Males with an apical calcar on middle tibiae; hind coxae simple and edentate beneath.

Fore wing with marginal cell three times as long as wide, and broadly, squarely truncate at apex; radial vein with first abscissa six- to seven-tenths the length of second abscissa; transverse cubital vein straight, oblique, inclivous, not more than half the length of second abscissa of cubitus which in turn is six-tenths to subequal in length to first abscissa of cubitus. Hind wing with anal lobe rather large, ovate, distinctly separated off, and two-thirds to three-fourths the length of submedian cell.

Abdomen slender, elongate, impunctate or at most finely punctate. First segment petiolate, two and a half to three times as long as wide at apex, the basal half very slender and petioliform becoming ampliate on distal third and perfectly sessile with wider base of second segment; abdomen more or less fusiform distad of first segment. Second to penult tergites with basal acarid chambers. Females on last tergite with a trigonal pygidial area which is more or less excavate and strongly narrowed apically, the lateral margins glabrous. Males without a pygidial area on ultimate tergite, the puncturation of which is no coarser than that of penult tergite; apical tergites and sternites simple, without processes or tubercles; hypopygium simple, flat.

GENOTYPE: *Crossocerus* (*Apocrabro*) *aëta* new species.

Ethology.—The biology of this group is unknown. However, inasmuch as the female pygidium is strongly narrowed and excavate apically, the species of *Apocrabro* are probably rubicolous or xylicolous.

Distribution.—The subgenus *Apocrabro* is an Oriental entity, known at present from only the insular fringes of that region. Its distribution ranges

from Formosa in the north, through the Philippines to as far south as Java. Whether or not *Apocrabro* is present on the Asiatic mainland is a matter for future investigation. Four species, which may be definitely referred to it, are now known: the Philippine *aëta*, the Formosan *loa*, and two new and still undescribed Javanese forms. In view of the close resemblance the component species bear to those of *Euplilis*, it is not unlikely that, when a critical study of all the Oriental Pemphilids is made, a number of previously described forms will be assigned to *Apocrabro*.

Crossocerus (Apocrabro) aëta[8] new species

From the following Formosan species *loa*, the Philippine *aëta* is distinguished by its larger size, dark mandibles, larger and more pronounced gular teeth, the bidentate lateral angles of the pronotum, and the differently sculptured dorsal face of the propodeum and pygidium, as well as the relatively longer clypeus and antennal scapes and different postocellar-ocellocular ratio.

Type.—♀; Galog River, Mt. Apo, Mindanao, Philippine Islands. Elevation, 6000 feet. September 27. (C. S. Clagg.) [Museum of Comparative Zoölogy.]

Female.—9.25 mm. long. Black, more or less fulgid; the following stramineous: scapes anteriorly, all tibiae with a small basal spot on outer faces, fore tibiae with an elongate spot on outer faces at apex, and all metatarsi and calcaria. Wings clear hyaline; veins and stigma deep brunneous.

Head fulgid; broadly subrectangular (two-thirds as high as broad) in anterior aspect; transversely and broadly subpanduriform in dorsal aspect (length medially seven-sixteenths, and laterally nine-sixteenths, the transverse width); clypeus entirely, and lower inner orbits with a narrow band of dense, appressed, sericeous, light golden pubescence; front above scapes with similar shorter decumbent pubescence; vertex with a thin vestiture of inconspicuous, erect, light aeneous, puberulent hair, scattered among which are longer erect setulae; temples and gular region with a thin clothing of appressed silvery hair. Front armed medially below, just above antennal sockets, with a large, strong and sharp, porrect spinoid tubercle; upper portion of front with fine, moderately close setigerous acupuncturation throughout. Vertex with puncturation similar to but more separated than that on upper front; supra-orbital foveae large but rather indistinct, ovate, glabrous and nitidous; postocellar line three-fourths the ocellocular distance; occipital carina distinct, well developed, terminating below in a large, strong, compressed and truncate tooth. Antennae with scapes straight to obscurely sinuous, inconspicuously obterete, about three-fourths (.76) the vertical eye length; pedicel cylindrical, glabrous, nitidous, seven-

[8] After the Aëta, the name applied to the aboriginal Negrito tribes living scattered throughout the interior of Mindanao and many of the larger islands of the Philippines.

sixteenths the length of first flagellar article; flagellum finely puberulent, first segment slender, elongate, twice the length of second, and flattened beneath on basal half, ultimate article simple, terete, four-thirds the length of penult segment. Clypeus short, transversely sublinear, median length about three-tenths (.285) the vertical eye length, the disc bisected by a glabrous, nitidous, rounded keel which terminates in the median tooth of the short, broad, tridentate median lobe, the apical margin below the middle of the broad lower eye orbits with a short, blunt and rounded bidentate process which is separated from median lobe by a broad, shallow, rounded excision. Mandibles long and slender, strongly decussate, somewhat angulate about middle; apices evenly bidentate; lower margins entire; inner margins with a low, almost imperceptible, obtuse angulation, and at base with a low obtuse dentiform angle.

Thorax fulgid; distinctly narrower than (in dorsal aspect but seven-tenths the width of) head; with a vestiture of rather long, but not very dense, griseous hair throughout; with fine, well separated, almost imperceptible acupuncturation dorsally and on pleura. Pronotum with lateral angles bidentate as a result of two sharp, sublaminate carinae which descend vertically; posterior margins strongly impressed. Mesonotum bisected by an indistinct double line on anterior half. Mesopleura with a sharp, strong, spinoid tubercle before middle coxae; episternal suture oblique, subconsute; hind margin simple, efoveate; metapleura glabrous, fulgid, traversed by fine, parallel, subhorizontal carinules. Propodeum subopaque to fulgid; posterior face and upper portions of lateral faces with a vestiture similar to mesopleura; dorsal face glabrous, perfulgid, impunctate, bisected by a broad marginate groove, on each side of which is a series of arcuate carinules radiating from anterior margin, separated from posterior face by a sharp, transverse carinule; posterior face bisected by a narrow, deep, submarginate cuneate impression, laterad of which the surface is strongly, horizontally striate; lateral faces strongly, finely subhorizontally striate.

Fore legs with trochanters slender, obterete, with a weak keel lengthwise below, and almost half the length of triquetrous femora; tibiae simple, obterete; metatarsi inconspicuously arched, with a dense brush of short, erect hair below, and with a pecten of short, stiff spines. Middle and hind tibiae weakly spinose on outer faces; middle tibiae with one apical calcar; hind tibiae with two acuminate calcaria, the longer two-thirds the length of hind metatarsi.

Fore wing with first abscissa of radial vein three-fifths the length of second abscissa; transverse cubital vein one-half the length of second abscissa of cubitus which in turn is five-eighths the length of first abscissa of cubitus. Hind wing with anal lobe two-thirs length of submedian cell.

Abdomen subfulgid, impunctate; with a very thin and inconspicuous

vestiture of short, decumbent, puberulent, light aeneous hairs which are longer, more plentiful and more noticeable on fifth tergite and sides of fourth tergite. First segment almost three times as long as wide at apex, the basal half slender, petioliform, gradually widened on apical third and perfectly sessile with base of wider second segment; abdomen subfusiform distad of first segment. Ultimate tergite with a trigonal pygidial area which is strongly narrowed and more or less excavate apically, the disc at base abruptly elevated into a semicircular platform which is microscopically coriaceous and with a row of punctures around the rather sharply marginate posterior edge, from the middle of which is emitted a longitudinal carinule that bisects half the remainder of the glabrous, perfulgid, almost impunctate pygidium, the lateral margins of which are glabrous. Sternites glabrous and nitidous save for a transverse subapical row of erect setulae.

This interesting Philippine species is known only from the unique female described above.

Crossocerus (Apocrabro) loa[9] new species

The present Formosan species is distinguished from the preceding Philippine form *aëta* by its smaller size, fulvous mandibles, the abruptly deflexed median clypeal carina, the different structure of the pronotum and pygidium, and the more finely sculptured propodeum.

Type.—♂; Taihorin, Formosa. Elevation, about 100 meters. May, 1910.

Male. 6.75 mm. long. Fulgid, immaculate black; palpi and tibial calcaria sordid fulvous; mandibles and all tarsi fulvofuliginous. Wings clear hyaline, iridescent; veins and stigma brunneous.

Head subquadrate in anterior aspect, subrectangular in dorsal aspect; a narrow band along lower inner orbits and clypeus with dense appressed silvery sericeous pile; upper portion of front and vertex with a thin vestiture of erect, light aeneous hair, temples with a similar clothing of more or less decumbent silvery hair. Front armed medially below with a minute spinoid tubercle; upper horizontal portion with fine, well separated, setigerous punctures throughout; vertex with acupuncturation like front; supraorbital foveae more or less distinct, elongate-oval; postocellar line two-thirds the ocellocular distance; occipital carina distinct, somewhat flanged and foveolate below where it terminates abruptly in a small dentoid process. Antennae with scapes five-ninths (.55) the vertical eye length; pedicel subcylindrical, two-thirds the length of first flagellar article; flagellum simple, finely puberulent, glabrous beneath, first segment slender, elongate, nine-fifths the length of second segment, ultimate article simple, terete, seven-fourths the length of penult segment. Clypeus short, about one-fourth (.22) the vertical eye length; transverse, flat and attenuate

[9] After the Loa, a tribe of the Pepo group, who formerly inhabited the Kagi district in south-central Formosa.

laterally to flatly tectate discally, bisected there by a strong, nitidous, glabrous carina; median lobe broad, its apical width one and a half times the medial clypeal length, the apical margin quadridentate, the lateral teeth more pronounced than median pair, and laterad of and separated from median lobe by a strong arcuate excision with another tooth. Mandibles moderately slender, the apices deeply and evenly bifid; lower margins entire; inner margins practically edentate.

Thorax with a fine, separated, setigerous acupuncturation throughout on dorsum and pleura; dorsally with a thin and inconspicuous vestiture of erect, moderately long hair; pleura and sterna similarly clothed with decumbent silvery hair. Pronotum at lateral angles with a single sharp vertical carinule, behind which is a low, transverse, compressed, subacute tuberculoid prominence; posterior margin strongly impressed. Mesonotum bisected on anterior half by a fine longitudinal line. Mesopleura with precoxal tubercle small and papilliform; episternal suture foveate; hind margin efoveate; metapleura perfulgid, traversed by a few parallel, subhorizontal costulae, hind margin foveolate. Propodeum fulgid; posterior face and posterior half of lateral faces with a vestiture of long, erect, rather shaggy, silvery hair; dorsal face with a large, glabrous, subtrigonal enclosure defined by a subfoveolate groove, bisected by a broad marginate furrow laterad of which the surface has weak striae radiating from the coarsely foveate anterior margin; posterior face bisected by a strong, immarginate, vertical impression, traversed below by a sub-basal horizontal carinule, below which the discal furrow is continued by a vertical carinule, the lateral surfaces indistinctly, finely, obliquely striate; lateral faces subhorizontally, arcuately striate.

Legs simple, unmodified. Middle tibiae with a flat, elongate acuminate calcar; hind tibiae with two calcaria, the longer flat, subcultriform, and almost six-tenths (.581) the length of hind metatarsi.

Fore wing with first abscissa of radial vein almost six-tenths (.581) the length of second abscissa; transverse cubital vein two-fifths the length of second abscissa of cubitus which in turn is four-fifths the length of first abscissa of cubitus. Hind wing with anal lobe three-fourths the length of submedian cell.

Abdomen fulgid; more or less imperceptibly punctate but with transverse, microscopically fine aciculation on second and following tergites; with a very thin, sparse and inconspicuous vestiture of short, decumbent light aeneous hair which is most noticeable on apical tergites. First segment three times as long as wide at apex, the basal half very slender and petioliform, gradually widened on apical third and perfectly sessile with second segment; abdomen subfusiform distad of first segment. Ultimate tergite without a pygidium, the puncturation very fine and no coarser nor more distinct than that of penult tergite; neither tergite with inflexed ventral

processes. Sternites fulgid, sparsely puberulent and impunctate; all simple, without processes or tubercles, their apical margins more or less truncate; hypopygium flat, apex quadrisetose.

Allotype.—♀; Taihorinsho, Formosa. Elevation, about 100 meters October, 1909.

Female. 8.5 mm. long. Black; the following fulvous: palpi, mandibles save for red apices, tegulae, tibial calcaria and all tarsi. Scapes deep stramineous anteriorly. Axillary sclerites light brunneous. Wings clear hyaline, iridescent; veins and stigma fuliginous.

Head fulgid; broadly subrectangular (five-eighths as high as broad) in anterior aspect, and broadly, transversely subpanduriform in dorsal aspect; clypeus entirely, and lower inner orbits with a narrow band of dense, appressed, sericeous, silvery-golden pubescence; front above apices of scapes with similar shorter decumbent pubescence; vertex with a thin vestiture of inconspicuous, erect, light aeneous, puberulent hair, scattered among which are longer erect setulae; temples and gular region with a thin clothing of appressed silvery hair. Front armed medially below with a minute tubercle; upper portion with fine, moderately close, setigerous puncturation throughout. Vertex with puncturation similar to but more widely spaced than on front; supra-orbital foveae large but rather indistinct, ovate, glabrous, nitidous; ocelli situated in a low equilateral triangle, the postocellar line about five-eighths (.64) the ocellocular distance; occipital carina well developed, particularly below where it is somewhat flanged and foveolate and terminates abruptly in a moderate dentiform process remote from hypostomal carinule. Antennae with scapes seven-tenths the vertical eye length; pedicel cylindrical, glabrous, nitidous; flagellum missing. Clypeus short, transversely sublinear; median length one-fifth the vertical eye length; the disc bisected by a glabrous, nitidous, rounded keel which is angulate at middle, the apical half sharply deflexed and terminating in the median tooth of the short, broad, tridentate median lobe; the apical margin beneath middle of the broad lower eye orbits with two contiguous teeth, the inner longer than the low rounded outer tooth, both separated from median lobe by a broad, shallow, rounded emargination. Mandibles long and slender, much as in *aëta*.

Thorax fulgid; distinctly narrower than (in dorsal aspect but three-fourths the width of) head; throughout with a vestiture of rather long but not very dense hair, which is erect and aeneous on dorsum, and somewhat decumbent and silvery on pleura; with fine, well separated, almost imperceptible acupuncturation dorsally and on pleura. Pronotum at lateral angles with a single sharp, sublaminate, vertical carinule, behind which is a bluntly acute, low tuberculoid process; posterior margin strongly impressed. Mesonotum as in male. Mesopleura with precoxal tubercle sharp, strong, spinoid; otherwise as in male. Propodeum in general as in male,

but dorsal surface separated from posterior face by a fine transverse carinule.

Legs slender, elongate, simple; in general as in *aëta*.

Wings generally as in male, but fore wings with first abscissa of radial vein seven-tenths length of second abscissa; cubitus with second abscissa seven-tenths length of first abscissa.

Abdomen in general as in male. Ultimate tergite with a trigonal pygidium which is strongly narrowed and excavate apically, the disc abruptly elevated at base into a sharply marginate sublunate platform, the surface of which is minutely coriaceous; apical half to two-thirds glabrous, perfulgid, with scattered punctures but not bisected by a carinule.

Specimens Examined: 5; 4 males, 1 female, as follows:

FORMOSA: Taihorin; elevation, about 100 meters; May, 1910: 2♂; October, 1909: 1♀. Anping; May, 1910: 2♂.

The paratypic males agree with the type in all essential features of livery and structural detail.

Subgenus BLEPHARIPUS Lepeletier & Brullé

Blepharipus Lepeletier & Brullé, Ann. Soc. Ent., France, III, p. 728, (1835); [in part].—Ashmead, Canad. Entom., XXXI, p. 217, (1899).—Perkins, Trans. Ent. Soc. London, p. 389, (1913).
Blepharipus (Section B [in part]) Packard, Proc. Ent. Soc. Phila., VI, p. 374, (1867).
Crabro (*Blepharipus*) A. Morawitz, Bull. Acad. Sci. St. Petersbourg, VII, p. 457, (1864).
Crabro (*Crossocerus*) Dahlbom, Hymen. Europ., I, p. 308, (1845); [in part].—Wesmael, Bull. Acad. R. Sci. Belg., XIX, p. 594, (1852); [in part].
Crabro (*Coelocrabro*) Thomson, Hymen. Scand., III, pp. 262, 264, (1874).—Berland, Faune de France, X, p. 184, (1925).—Schmiedeknecht, Hymen. N. u. Mitteleurop., Zw. Aufl., p. 649, (1930).
Coelocrabro Richards, Gen. Names Brit. Ins., pt. 5, Hymen. Acul., p. 106, (1937).
Crabro (Group *ater*) Fox, Trans. Amer. Ent. Soc., XXII, p. 194, (1895).
Crabro (Group *planipes*) Fox, Trans. Amer. Ent. Soc., XXII, p. 193, (1895); [in part].
Stenocrabro Ashmead, Canad. Entom., XXXI, p. 216, (1899); [in part].
Crabro (Haupt-Artengruppe *Crabro:* Artengruppe *Coelocrabro*) Kohl, Ann. K. K. Naturhist. Hofmus. Wien, XI, p. 490, (1896).
Crabro (Artengruppe *Crossocerus:* Untergruppe *Coelocrabro*) Kohl, Ann. K. K. Naturhist. Hofmus., Wien, XXIX, pp. 195, 222, (1915); [in part].
Crabro (*Crossocerus Blepharipus*) Pate, Amer. Ent. Soc. Mem. no. 9, p. 14, (1937).

GENOTYPE: *Blepharipus nigrita* Lepeletier & Brullé, 1835[10] [=*Crossocerus* (*Blepharipus*) *nigritus* (Lepeletier & Brullé)]. (By designation of Ashmead, 1899, Canad. Entom., XXXI, p. 215.)

The species of *Blepharipus* are small fulgid forms with the head and thorax generally, and the abdomen always, immaculate black. The component forms often superficially resemble those of the nominate subgenus but may be readily distinguished from them in the female sex by the tridentate mandibles and the strongly narrowed and excavate pygidium, and in the males by the rather elongate and subtrigonal ultimate abdominal tergite which is no more coarsely punctate than the preceding tergite.

[10] The exact identity of *Blepharipus nigrita* Lepeletier & Brullé, 1835 is somewhat uncertain. European authors generally consider it the same as *Crabro pubescens* Shuckard, 1837.

Diagnostic Features.—Small, fulgid, finely punctate forms. Head subquadrate in anterior aspect, broadly subrectangular in dorsal aspect. Front simple, unarmed, and on anterior vertical aspect between inner orbits narrow, somewhat concave discally but without a marginate scapal sinus; upper horizontal portion of front on same plane as vertex and usually bisected anteriorly by a furrow running forward from median ocellus. Vertex flat, with supra-orbital foveae distinct or indistinct in both sexes; ocelli moderately large, arranged in an equilateral triangle. Temples moderate, ecarinate and unarmed in both sexes; occipital carina moderate, and neither appreciably flanged, foveolate, a complete circle in extent, attaining the hypostomal carinule, nor terminating below in a spine or tubercle in either sex. Antennae distinctly thirteen-segmented in males, and twelve-segmented in females; scapes straight, cylindrical, ecarinate; flagellum simple in both sexes, in males fringed beneath with erect hairs. Clypeus short, transverse, the disc flat, tumid or more or less tectate, usually with a more or less well developed median lobe. Mandibles with apices bidentate in males, tridentate in females; both sexes with lower margins entire and inner margins edentate. Females without a psammophore.

Thorax finely punctate at most throughout. Pronotum short, transverse, the anterior dorsal margin ecarinate. Mesonotum, axillae, scutellum and postscutellum simple. Mesopleura finely punctate; prepectus anteriorly with a sharply margined epicnemium; episternal suture and mesopleural pit distinct; with or without a tubercle before middle coxae; mesosternum rounded anteriorly. Propodeum finely, rarely coarsely, sculptured; dorsal face generally with a trigonal or semicircular enclosure; lateral carinae present at least along posterior face.

Legs simple in females and without a pecten on fore tarsi; in males simple or modified. Middle tibiae with a distinct apical calcar in both sexes.

Abdomen immaculate black, more or less fulgid, impunctate or at most finely acupunctate; first segment sessile with second and no longer than wide at apex; general shape more or less fusiform in both sexes. Males without a pygidial area on last tergite which is no more coarsely punctate than preceding segment; ultimate tergite simple or with inflexed ventral processes; apical sternites simple or seventh with median tubercle or carina. Females with pygidium strongly narrowed and more or less excavate apically.

Nomenclatorial Notes.—The name *Blepharipus* has been almost universally employed by American authors for this complex, but in Europe the group is known sometimes as *Blepharipus* and sometimes as *Coelocrabro*. This, of course, is due to a lack of agreement as to what is the correct type of *Blepharipus*. Some European authors, following the dictum expressed in Opinion 71 of the International Commission on Zoological Nomenclature, consider that Westwood in 1839 in the generic synopsis

appended to his Modern Classification of Insects designated *Crabro dimidiatus* F.,[11] as type of *Blepharipus*. But Westwood, no doubt reflecting the views expressed in 1837 by Shuckard, rejected the generic names of Lepeletier and Brullé, and specifically stated in his generic synopsis: "This genus [i.e. *Crabro*] has been greatly cut up by St. Fargeau. The following are such of his genera as have been found in this country [i.e. Great Britain], together with examples of each."[12] Then follow the generic names of Lepeletier and Brullé in square brackets, each with a specific *example:* Westwood therefore cannot be regarded as having fixed the types of these names. The first valid fixation of a type for *Blepharipus* was made by Ashmead who in 1899 selected *Blepharipus nigrita* Lepeletier & Brullé.[13] At the same time Ashmead stated that: "Blepharipus Lepel, et Br. = Coelocrabro Thoms." and thus may also be regarded as having fixed this species as type of *Coelocrabro* Thomson, 1874.

Ethology.—The species of *Blepharipus* are xylicolous or rubicolous. Their nests are constructed in a variety of situations: in the wood of old rotten logs and stumps (beech, peach, etc.), the trunks of spruces, the stems and twigs of ash, beech, alders and viburnums, in the pithy twigs of elders and sumac, in raspberry canes, and even in the stems of healthy cat-tails (*Typha*). Goureau found a nest of *leucostomoides* Rich. [=*leucostoma* Auctt. *nec* L.] in the old abandoned tunnels made by the larva of a cerambycid (*Oberea*) in the stems of honeysuckle (*Lonicera caprifolium*). Most *Blepharipus* provision their nests with Diptera of various families (Tipulidae, Chironomidae, Ceratogonidae, Simuliidae, Sciaridae, Stratiomyiidae, Rhagionidae, Dolichopodidae, Empididae, Syrphidae, Pipunculidae, Ephydridae, Lonchaeidae, Lauxaniidae, Sepsidae, Chloropidae, Anthomyidae, Muscidae), but some like *ambiguus* prey exclusively upon Homoptera (Cicadellidae, particularly Typhlocybinae, and Psyllidae), while a few such as *leucostoma* L. [=*carbonarius* Dahlbom] and *cinxius* store the cells of their nests with both Diptera and Hemiptera (Psyllidae, Aphididae, and nymphs of Coreidae and Miridae). Nielsen has found that *walkeri* captures only the mayfly *Chloëon*, while Hamm and Richards record finding fragments of a sawfly (*Pristiphora* or *Pachynematus* sp.) in a nest of *leucostomoides* otherwise filled with various Diptera.

A number of Hymenopterous and Dipterous parasites of the European species of *Blepharipus* are known. The Ichneumonids *Cryptus analis* Grav., and *Tryphon signator* Grav., are both parasitic upon *leucostomoides* Rich.; and in the Chalcids, *Habritys brevicornis* Ratz., parasitizes *leucostomoides* Rich., and *Diomorus armatus* Boh., has been taken from the nests

[11] Lepeletier and Brullé in 1835 listed *Crabro dimidiatus* F., as a doubtful synonym of *Crabro signatus* Panzer, a species originally included in *Blepharipus*.

[12] Westwood, Introd. Mod. Class. Insects, II, Generic Synopsis, p. 80, (1839).

[13] *Cf.* Pate, 1937, Mem. Amer. Ent. Soc., no. 9: *Blepharipus*, p. 14, footnote 33; and *Coelocrabro*, p. 19, footnote 50.

of *pubescens* Shuckard. Four Sarcophagids: *Macronychia polyodon* Mg., *Ptychoneura cylindrica* Fall., *Pt. rufitarsis* Mg., and *Pt. crabronum* Kr., have been reared from *capitosus* Shuck.; and the Anthomyid fly, *Eustalomyia festiva* Zett., from *leucostomoides* Rich.

An excellent summary of the biology of the Palaearctic *Blepharipus* was given by Kohl in 1915, while in 1926 Hamm and Richards presented a detailed account of the ethology of the British species. The following papers contain the more important observations upon the biology of the species of *Blepharipus*.

Adlerz, G.—Lefnadsforhallenden och instinkter inom Familjerna Pompilidae och Sphegidae, III. *K. Svenska Vetensk. Handl.*, XLV, no. 12, pp. 1–75, (1910). [*leucostoma* L. under the designation *carbonarius* Dahlb., p. 46; *cinxius* Dahlb., p. 47.]

Baer, U.—Über das Brüten von Grabwespen in gekappten Baumzweigen. *Allgem. Zeitschr. Ent.*, VI, pp. 161–163, (1901). [*capitosus* Shuck.]

Bold, T. J.—The economy of Crabro cetratus. *Zoologist*, XI, p. 3778, (1853).

—Capture of a fossorial hymenopterous insect, new to the British fauna. *Zoologist*, XV, p. 5631, (1857). [*leucostoma* L., under the designation *carbonarius* Dahlb.]

Borries, H.—Bidrag til danske Gravehvepses Biologi. *Vidensk. Meddel. naturhist. Foren. Kjobenhavn*, pp. 1–143, (1897). [*capitosus* Shuck., p. 33; *ambiguus* Dahlb., p. 34.]

Box, L. A.—*Crabro capitosus* Shuck., in the Midlands. *Ent. Monthly Mag.*, LV, pp. 17–18, (1919).

Dahlbom, A. G.—Hymenoptera Europaea, (1845). [*leucostomoides* Rich., I, p. 342.]

Davidson, R. H. & B. J. Landis.—Crabro davidsoni Sandh., a wasp predacious on adult leafhoppers. *Ann. Ent. Soc. Amer.*, XXXI, pp. 5–8 (1938). [*ambiguus* Dahlb., as *davidsoni* Sandh.]

Enslin, E.—Ueber Bienen und Wespen aus Nordbayern. *Arch. f. Naturges.*, LXXXVI, hft. 6, p. 233, (1922). [*Diomorus armatus* Boh., recorded as a parasite of *pubescens* Shuck.]

Fletcher, J. E.—*Crabro leucostoma* L., its nidification and two parasites. *Ent. Monthly Mag.*, XXV, p. 400, (1889). [*leucostomoides* Rich.]

Goureau, C. G.—Notes sur les Larves de quelques Insectes et sur les lieux qu'elles habitent. *Ann. Soc. Ent. France*, (4), VI, pp. 169–174, (1866). [*leucostomoides* Rich., as *niger* Lep., p. 174.]

Hamm, A. H. & O. W. Richards.—The biology of the British Crabronidae. *Trans. Ent. Soc. London*, 1926, pp. 297–331, (1926). [*leucostomoides* R., pp. 309, 323; *pubescens* Shuck., and *inermis* Thoms., p. 310; *capitosus* Shuck., p. 311, 324; *cetratus* Shuck., p. 312; *ambiguus* Dahlb., pp. 312, 324; *walkeri* Shuck., p. 313; *leucostoma* L., as *carbonarius* Dahlb., p. 313.]

Jannson, A.—Zur Lebensweise einiger Hymenoptera. *Ark. Zool.*, XII, no. 12, (1919). [*ambiguus* Dahlb., as *gonager* Lep. & Br.]

Kohl, F. F.—Die Crabronen der paläarktischen Region. Monographische Arbeit. *Ann. K. K. naturhist. Hofmus. Wien*, XXIX, pp. 1–453, (1915). [*capitosus* Shuck., p. 401; *cinxius* Dahlb., p. 407; *leucostomoides* Rich., as *leucostoma* L., p. 409; *cetratus* Shuck., p. 410; *inermis* Thoms., p. 410; *tirolensis* Kohl, p. 412; *walkeri* Shuck., p. 413; *leucostoma* L., as *carbonarius* Dahlb., p. 414; *ambiguus* p. 415.]

Kramer, A.—Zwei neue deutsche Musciden. *Zool Jahrb., Abt. Syst.*, XLIII, p. 329, (1920). [Diptera parasites of *capitosus* Shuck.]

Maneval, H.—Notes sur quelques Hymenopteres fouisseurs. *Bull. Soc. Ent. France*, pp. 28–32, (1928). [*leucostomoides* Rich., as *leucostoma* L., p. 30.]

Marechal, Paul.—Etudes sur les rubicoles: I. Colelocrabro capitosus Shuck. *Ann. Soc. Ent. France*, XCVI, pp. 101–109, (1927).

Meyer, O.—Hymenoptera Aculeata der Provinz Posen. *Deutsche Ent. Zeit.*, 1919, pp. 145–160, (1919). [*ambiguus* Dahlb., p. 148.]

Nielsen, J. C.—Biologiske Studier over Gravehvepses. *Vidensk. Meddel. naturhist. Foren. Kjobenhavn*, 1900, pp. 255–280, (1900). [*leucostomoides* Rich., p. 259; *walkeri* Shuck., as *cloevorax* Niels., p. 261.]

—Iagttagelser over nogle danske Gravehvepses Biologi. *Entom. Meddelser*, (1), VII, pp. 110–114, (1903). [*leucostomoides* Rich., p. 111.]

RUDOW, F.—Lebensweise und Nestbau der Raub-, Mord- und Grabwespen, Sphegidae und Crabronidae. *Entom. Zeitschr.*, XXVI, pp. 75–76, (1912). [*tirolensis* Kohl.]

SAUNT, S. W.—Notes on the prey of Crabro (Coelocrabro) leucostoma L. *Ent. Monthly Mag.*, LXI, p. 257, (1925). [*leucostomoides* Rich.]

SCOTT, HUGH.—Notes on the nesting habits and prey of two British Crabronidae. *Ent. Monthly Mag.*, LXI, pp. 156–160, (1925). [*cetratus* Shuck., p. 156; *pubescens* Shuck., p. 157.]

VERHOEFF, C.—Beiträge zur Biologie der Hymenoptera. *Zool. Jahrb., Abt. Syst.*, VI, pp. 680–754, (1892). [*capitosus* Shuck., p. 717; *inermis* Thoms., under designation *sambucicola* Verh., p. 720.]

WALLIS, E. F.—Diptera in the nests of Crabro. *The Entomologist*, LII, p. 14, (1919). [*leucostomoides* Rich.]

WATKINS, C. J.—The denizens of an old cherry tree. *Internat. J. Microsc. & Nat. Sci.*, XIV,(1895). [*leucostomoides* Rich.]

Distribution.—The subgenus *Blepharipus* is predominantly Holarctic in distribution, with a few representatives in the Neotropical and Oriental Regions.

Species Groups.—The Nearctic species of *Blepharipus* have long been in need of critical study. Hitherto, much stress has been laid upon the propodeal sculpture, but this varies considerably, though within certain limits, and thus for the most part is a very unreliable criterion for the differentiation of species. On the other hand, little or no attention has been paid to the many distinctive characters in the conformation of the legs, the clypeus and antennae, the female pygidium, and the structure of the ultimate abdominal tergites and sternites of the males, and the presence or absence of hair brushes on the fore legs and the thoracic sterna.

Analysis of the structural characters displayed by males of the Nearctic species and comparison of them with Palaearctic forms indicates there are at least two species groups of *Blepharipus* represented in the Nearctic fauna. The more generalized of these is the Leucostoma Group, which comprises the North American species *harringtonii*, *stricklandi*, *columbiae*, *pammelas*, *cinctipes*, the Holarctic *ambiguus*, and such Palaearctic forms as *cetratus* and *leucostoma* (olim *carbonarius* Dahlb.). The species have the hind femora rounded below as a rule, the mesopleura usually without a tubercle before the middle coxae, and the clypeal lobe truncate to rounded out apically. In addition, the males have the ultimate abdominal tergites and sternites simple and unmodified; moreover, in this sex there is a marked tendency for the fore tibiae and tarsi to become flattened, even patellate in some cases.

The Pubescens (or Nigritus) Group includes the Nearctic forms *tarsalis*, *impressifrons*, *nigricornis*, *stictochilos*, *fergusoni*, and a number of European species such as *pubescens* and *leucostomoides* (olim *leucostoma* Auctt. nec. L.). The component forms generally have the hind femora provided with a sharp trenchant edge lengthwise below, the mesopleura armed with a tubercle before the middle coxae, and the clypeal lobe tricrenulate at apex. In the males, the ultimate abdominal tergite is provided laterally with abruptly inflexed ventral prongs which overlie the base of the seventh

sternite, the disc of which is furnished with a prominent V- or Y-shaped tubercle. In comparison with the Leucostoma Group, there is relatively little tendency for the anterior tibiae or tarsi to be flattened. All the structural features of the Pubescens complex indicate that it is one of the more highly specialized groups of *Blepharipus*. In some such ancestral stock, the *Acanthocrabro-Nothocrabro-Cuphopterus* and *Stictoptila* series unquestionably had their origin.

The appended key will serve not only to differentiate, but also to briefly characterize, the Nearctic species of *Blepharipus*.

Types Studied.—The types of all the described Nearctic *Blepharipus* have been studied except those of the following species:

Crabro ambiguus Dahlbom: Kohl's interpretation of this Holarctic species has been accepted.

Blepharipus cinctipes Provancher and *Blepharipus nigricornis* Provancher: The interpretation of Fox has been followed for these forms.

Crabro tibialis Say, not Gmelin, Olivier, nor Fabricius (renamed *impressifrons* by Smith): The type is lost or destroyed. The current interpretation of this species has been followed.

KEY TO THE NEARCTIC SPECIES OF BLEPHARIPUS

1. Abdomen with seven visible tergites; antennae thirteen-segmented, flagellum more or less distinctly fringed beneath with hair; males 2
   Abdomen with six visible tergites, the last with a trigonal pygidial area which is strongly narrowed and excavate apically; antennae twelve-segmented, flagellum not fringed beneath with hair; females 11
2. Abdomen with seventh sternite furnished with a V- or Y-shaped tubercle or keel discally, laterad of which are inflexed prongs of seventh tergite; hind femora usually with a trenchant edge lengthwise below; mesopleura often with a small tubercle before middle coxae; clypeus usually keeled and more or less tectate discally, and with a produced median lobe, the apex of which is tricrenulate or tridentate, the median tooth the largest and most distinct . . 3
   Abdomen with seventh sternite and tergite simple, the former without a discal tubercle, the latter without inflexed ventral prongs; hind femora rounded beneath; clypeus variously formed 7
3. Fore tarsi spirally distorted; pronotum with a vertical carina at each lateral angle. (Fore trochanters, femora and tibiae flattened beneath, the last two with a thin brush of villous hair beneath; inflexed ventral prongs of last tergite thickened but not clubbed at apex; seventh sternite bisected by a low Y-shaped keel) ..... *tarsalis* (Fox)
   Fore tarsi simple, not distorted; pronotum without a vertical carina at each lateral angle . . . 4
4. Fore legs with trochanters, femora and tibiae more or less strongly flattened beneath and provided there with a rather dense brush of hair; mesosternum with a conspicuous, heavy brush of white hair 5
   Fore legs with trochanters, femora and tibiae not markedly flattened nor densely hirsute beneath; mesosternum with normal clothing of hair 6
5. Last abdominal tergite with inflexed ventral prongs strongly clubbed, truncate and concave at apex; seventh sternite discally with a high subcristate keel forked caudally; pronotum, scutellum, tibiae, tarsi and scapes bright yellow; (eastern forms) . . *impressifrons* (F. Smith)
   Last abdominal tergite with inflexed ventral prongs simple, flat, not clubbed at apex; seventh sternite bisected by a low inconspicuous keel discally; almost wholly immaculate black forms; (Oregon) ..... *fergusoni* new species
6. Hind femora with a trenchant edge lengthwise below; propodeum with lateral carinae obsolescent along dorsal face which is bisected by a narrow marginate but efoveate sulcus; pos-

terior propodeal face with discal fovea immarginate; supra-orbital foveae large, distinct; mesonotum sparsely acupunctate; clypeus keeled discally; inflexed ventral prongs of last abdominal tergite strongly clubbed, truncate and slightly concave caudally at apex; seventh sternite with a high subcristate Y-shaped keel discally; clypeus and pronotum immaculate black ..... *nigricornis* (Provancher)

Hind femora rounded beneath, without a trenchant edge; propodeum with lateral carinae well developed along dorsal face and extending forward as far as the spiracle; dorsal face bisected by a broader, strongly marginate and foveate sulcus; posterior face with discal impression marginate; supra-orbital foveae small and indistinct; mesonotum distinctly and more closely punctate; clypeus merely tumid discally; inflexed ventral prongs of last abdominal tergite thickened to weakly clubbed at apex; seventh sternite with a low Y-shaped keel on disc; clypeus and pronotum each with a pair of small white spots ..... *stictochilos* new species

7. Mesopleura with a tubercle before middle coxae; propodeum coarsely sculptured, the posterior face coarsely areolate. (Clypeus with disc weakly keeled and tectate, the lobe tricrenulate with median tooth the most distinct; supra-orbital foveae small, indistinct; last flagellar segment somewhat compressed, arcuate and truncate at apex; fore legs with femora slightly, and tibiae distinctly flattened beneath and glabrous there, the tarsi distinctly flattened) ..... *cinctipes* (Provancher)

Mesopleura without a tubercle before middle coxae; propodeum more finely sculptured, the posterior face never coarsely areolate 8

8. Fore tarsi and tibiae strongly explanate, the tarsi patellate, the tibiae hirsute beneath; fore trochanters angulate posteriorly; fore femora angulate at base; clypeus with disc weakly keeled and tectate, the lobe tricrenulate, the median tooth the largest; last flagellar segment simple, obterete. (Supra-orbital foveae distinct, sublunate, oblique) .. *ambiguus* (Dahlbom)

Fore tarsi more or less flattened but not distinctly patellate; fore trochanters not angulate posteriorly; fore femora not angulate at base; clypeus with disc flat or tumid but not keeled, the median lobe more or less rounded out; last flagellar segment more or less compressed, arcuate, and truncate apically 9

9. Fore trochanters, femora and tibiae flattened beneath, the latter two more or less explanate and with a dense brush of hair beneath. (Supra-orbital foveae large, distinct, elongate-cuneate) ..... *pammelas* new name

Fore trochanters cylindrical, obterete; the femora and tibiae if flattened and more or less explanate, without a dense brush of hair beneath 10

10. Antennal flagellum with first nine segments furnished beneath with a compressed elongate tubercle, at apex of which is a number of erect setulae; supra-orbital foveae large, distinct, lunate; neither fore tibiae nor tarsi appreciably flattened beneath .. *stricklandi* new species

Antennal flagellum normal, without such tubercles beneath, the hair fringes extending the full length of each flagellar article; supra-orbital foveae small, indistinct, oval, ovate or pyriform; fore tibiae and tarsi distinctly flattened but glabrous beneath, the former somewhat explanate posteriorly ..... *columbiae* (Bradley)

11. Mesopleura with a small tubercle before middle coxae 11

Mesopleura simple, without a tubercle before middle coxae 16

12. Hind femora with a trenchant edge lengthwise below; propodeum relatively weakly sculptured, the dorsal face usually without a very well defined enclosure; clypeus tridentate or tricrenulate medio-apically, the disc keeled or tectate 13

Hind femora rounded, without a trenchant edge lengthwise below; propodeum relatively coarsely sculptured, the dorsal face with a well defined enclosure; pygidial disc rather abruptly elevated at base into a flat, punctate, trigonal platform 15

13. Pronotum with a vertical carina at each lateral angle; vertex sparsely acupunctate; supra-orbital foveae indistinct, ovate-reniform; pygidial disc gently tumid or only moderately elevated into a trigonal platform at base; propodeum with an enclosure defined on dorsal face ..... *tarsalis* (Fox)

Pronotum without a vertical carina at each lateral angle; vertex distinctly punctate; supra-orbital foveae distinct, elongate-cuneate; pygidial disc abruptly elevated at base into a flat, punctate, trigonal platform 14

14. Propodeum with little if any indication of an enclosure on dorsal face; immaculate black forms ..... *nigricornis* (Provancher)

Propodeum with a rather well defined dorsal enclosure; pronotum, scutellum, tibiae, tarsi and scape bright yellow ..... *impressifrons* (Smith)

15. Propodeum very coarsely sculptured, the posterior face with transverse rugulae, dorsal face with the enclosures small, laterally with a strongly foveate sulcus extending forward to spiracles; clypeal lobe truncate to rounded out medially; immaculate black forms ..... *cinctipes* (Provancher)

Propodeum not so coarsely sculptured, posterior face without transverse rugulae, dorsal face with two large nitidous enclosures, laterally with foveate sulcus obsolescent; clypeal lobe tricrenulate; the following white: pronotum dorsally and clypeus each with a pair of small white spots, pronotal tubercles, antennal scapes anteriorly, and portions of legs ..... *stictochilos* new species

16. Clypeus transverse, flat discally, not produced medially into a lobe but with two large median teeth separated by a deep semicircular emargination; pygidium glabrous, nitidous throughout, the disc flat or at most very gently tumid at base. (Supra-orbital foveae large, distinct, broadly lunate, oblique in position; propodeum with dorsal enclosure well defined) ..... *ambiguus* (Dahlbom)

Clypeus tumid or tectate discally, produced into a more or less rounded out or truncate median lobe; pygidium punctate at base and elevated into a trigonal platform or strongly tumid discally 17

17. Pygidium gently tumid at base, punctate, and bisected by a fine carinule; propodeum with a rather well defined dorsal enclosure, the lateral foveolate furrow not extending forward along the dorsal face, the bisecting furrow of which is strongly marginate. (Supra-orbital foveae small, oblique, lenticular) ..... *pammelas* new name

Pygidium abruptly elevated at base into a closely punctate, trigonal platform and not bisected by a longitudinal carinule; propodeum on dorsal face without or with a poorly defined enclosure, the bisecting furrow more or less immarginate, the posterior face laterally with a foveate furrow extending well up onto and forward along dorsal face toward the spiracles . 18

18. Vertex sparsely acupunctate; supra-orbital foveae small, ovate-reniform; clypeal disc tumid; propodeum nitidous on dorsal face and without indication, or at best but a feeble one, of a defined enclosure ..... *harringtonii* (Fox)

Vertex distinctly punctate; supra-orbital foveae large, distinct, broadly obcuneate; clypeal disc tectate; propodeum on dorsal face with a relatively well defined enclosure ..... *columbiae* (Bradley)

Crossocerus (Blepharipus) ambiguus (Dahlbom), new comb.

? Crossocerus gonager Lepeletier & Brullé, Ann. Soc. Ent. France, III, p. 785, (1835); [♀; near Versailles, France].

Crabro ambiguus Dahlbom, Dispos. meth. Hymen., p. 14, (1842); [♀].—Pate, Notulae Naturae, no. 91, p. 8, footnote 4, (1941); [*davidsoni* Sandhouse, 1938 and *parkeri* Banks, 1921 recorded as synonyms].

Crabro (*Crossocerus*) *ambiguus* Dahlbom, Hymen. Europ., I, pp. 336, 523, (1845); [♂, ♀; Germany and Sweden].

Crabro (*Coelocrabro*) *ambiguus* Kohl, Ann. K. K. Naturhist. Hofmus. Wien, XXIX, p. 237, pl. 5, fig. 120, pl. 6, fig. 142, (1915); [♀, ♂; full synonymy, description, range in Palaearctic region].—Berland, Faune de France, X, p. 184, (1925); [♀, ♂].—Schmiedeknecht, Hymen. N. u. Mitteleuropas, Zw. Aufl., p. 650, (1930); [♀, ♂].

Coelocrabro ambiguus Richards, Gen. Names Brit. Ins., Pt. 5, Hymen. Acul., p. 106, (1937).

Blepharipus ambiguus Hamm & Richards, Trans. Ent. Soc. London, pp. 17–18, 324–326, (1926); [biology].

Blepharipus parkeri Banks, Ann. Ent. Soc. Amer., XIV, p. 17, (1921); [♀, Lexington, Mass.].

Crabro (*Blepharipus*) *davidsoni* Sandhouse, Ann. Ent. Soc. Amer., XXXI, p. 1, (1938); [♀, ♂; Ohio: Columbus (type loc.), Wooster, Greenville. Illinois: Chicago. Maryland: Woodstock. New York: Rochester. Canada: Montreal.].—Davidson & Landis, Ann. Ent. Soc. Amer., XXXI, pp. 5–8, (1938); [biology].—Krombein, Bull. Brooklyn Ent. Soc., XXXIV, p. 144, (1939); [New York: Forest Lawn, Buffalo; Rome; Ithaca; Breesport; Granby Center Swamp; Poughkeepsie; Yonkers].—Pate, Ent. News, LI, p. 34, (1941); [placed in synonymy of *parkeri* Banks, 1921].—Pate, Notulae Naturae, no. 91, p. 8, (1941); [placed in synonymy of *ambiguus* Dahlbom, 1842].

Type.— ♀; Lund, Sweden. August 2, 1835. (A. G. Dahlbom; on the leaves of plants.) [University of Lund?]

The patellate fore tarsi and the strongly explanate fore tibiae of the males, and the distinctive conformation of the female clypeus readily distinguish *ambiguus* from all other *Blepharipus*. Kohl, in his monograph of the Palaearctic Crabrones, figured and gave an excellent diagnosis of the species, and the late Miss Sandhouse recently presented a full description of American specimens of *ambiguus* under the name *davidsoni*.

Synonymical Notes.—Most European authors now follow Kohl and use Dahlbom's 1842 name *ambiguus* for the present species, but there is a possibility that it may have been first described in 1835 as *gonager* by Lepeletier and Brullé. This point, however, cannot be finally settled until the type of *gonager* is located and studied: it may eventually be found in the Spinola Collection at the Museo Zoologia et Anatomia comparata della Reale Universitá in Turin, Italy. In 1921 Banks described American specimens as *parkeri*, and subsequently in 1938 the late Miss Sandhouse redescribed the species under the name *davidsoni*. As I have already noted elsewhere, comparison of Nearctic material of *davidsoni* and *parkeri* with European specimens determined by Kohl as *ambiguus* Dahlbom has revealed no essential difference, and consequently I have relegated both names into the synonymy of *ambiguus* Dahlbom.

Ethology.—Davidson and Landis presented an excellent account of the biology of *ambiguus* in 1938. In Ohio, the wasp excavates galleries in the rotten wood of peach stumps, rotting fence posts, and even the porches of houses. The nests are stored with a variety of Typhlocybine leafhoppers of the genera *Empoasca*, *Erythroneura* and *Typhlocyba*. Hamm and Richards record similar nesting sites and prey for *ambiguus* in England, noting, however, that many of the Typhlocybines captured and stored were heavily parasitized by Pipunculid flies of the genus *Chalarus* or Dryinid wasps of the genus *Aphelinus*.

Distribution.—This is one of the commonest species of *Blepharipus* in northeastern North America, ranging from Quebec to Maryland and from the Atlantic coast at least as far west as Chicago, Illinois. Whether *ambiguus* is a native or introduced form cannot now be determined. But the fact that such a common species was unknown to Fox in 1895 and was not recorded from North America until 1921 when Banks described it as *parkeri* from Lexington, Massachusetts, may denote that it has been accidentally introduced, perhaps in nursery stock or lumber, and become established only in the past fifty years. Yet its present wide range, which will probably be amplified when more material is studied, would seem to preclude this thesis and indicate that, like *Euplilis clavipes* and *E. coarctatus* (olim *Rhopalum pedicellatum* Auctt., *nec* Packard), *ambiguus* is a relatively ancient form with an Holarctic distribution. According to Kohl, *ambiguus* is broadly distributed throughout Europe and the British Isles.

Nearctic specimens examined: 57; 34 females, 23 males, as follows:

MASSACHUSETTS: Lexington; July 24; (N. Banks); 6 ♀; [type and paratypes of *parkeri* Banks; M. C. Z.]. Cambridge; July; (N. Banks); 4 ♀. Forest Hills; June 23–25, 1921; (nest in tree stumps); 6 ♀.

NEW YORK: Ithaca, Tompkins Co.; June 4–September 5; 14 ♂, 8 ♀; (W. W. Middlekauff: reared from nests in old cherry log: emerged April 10–15, 1935): 5+ ♀, 5+ ♂. Ellis Hollow, Tompkins Co.; August 2, 1932; 1 ♀. Ringwood, Tompkins Co.; June 26, 1920; 1 ♀. Kingston, Ulster Co.; July 15, 1936; 1 ♂. 8720 96th Street, Woodhaven, Queens Co., Long Island; June 5, 1937; (John C. Linz; reared from dead cherry tree): 1 ♂.

NEW JERSEY: Palisades, Bergen Co.; September 12, 1920; (nest in dead trees): 2 ♀. Ramsey, Bergen Co.; September 15, 1917; 1 ♀.

PENNSYLVANIA: Arendtsville, Adams Co.; June 21, 1921; (S. W. Frost); 1 ♂. North Braddock, Allegheny Co.; August 22, 1928; (H. A. Scullen); 1 ♀. Pittsburgh, Allegheny Co.; August 23, 1928; (H. A. Scullen); 1 ♀.

Also recorded as *davidsoni* from: Canada (Montreal). New York (Granby Centre Swamp, Oswego Co.; Rochester; Forest Lawn Cemetery, Buffalo; Rome: Breesport (on current aphids); Ithaca; Poughkeepsie; and Yonkers). Maryland (Woodstock). Ohio (Columbus; Greenville; Wooster). Illinois (Chicago).

Crossocerus (Blepharipus) pammelas new name

Crabro ater Cressen, Proc. Ent. Soc. Phila., IV, p. 477, (1865); [♀; mountain region, Colorado Territory]; [*nec* Olivier, 1791, Encycl. Méthod., VI, p. 517].—Cresson, Trans. Amer. Ent. Soc., Suppl. vol., p. 284, (1887); [Canada; Maine; Virginia; Colorado].—Fox, Trans. Amer. Ent. Soc., XXII, p. 197, (1895); [♀, ♂; Colorado; Washington; Mt. Hood, Oregon; Brunswick, Maine; New Hampshire].—Kincaid, Ent. News, XI, p. 359, (1900); [♀, ♂; Olympia, Washington].—Cresson, Amer. Ent. Soc. Mem. no. 1, p. 102, (1916); [♀; lectotype designated].—Carter, Canad. Entom., LVII, p. 131, (1925); [♀; Waterton, Alberta].

Crabro (*Blepharipus*) *ater* Rohwer, Ent. News, XIX; p. 246, (1908); [♂; Florissant, Colorado; at flowers of *Heracleum lanatum*].—Johnson, Biol. Surv. Mt. Desert Reg., Pt. I, p. 157, (1927); [Mt. Desert I., Maine].

Solenius (*Blepharipus*) *ater* Bradley, Cornell U. Agr. Exp. Sta. Mem. 101, p. 1021, (1928); [McLean, New York].

Blepharipus ater Packard, Proc. Ent. Soc. Phila., VI, p. 374, (1867); [♀, ♂; Colorado; West Virginia; Brunswick, Maine].—Provancher, Natural. Canad., XIII, p. 133, (1882); [♀; Quebec].—Provancher, Faun. entom. Canad., p. 667, (1883); [♀].—Ashmead, Canad. Entom., XXXI, p. 217, (1899); [♀, ♂].—Kincaid, Proc. Washington Acad. Sci., II, p. 508, (1900); [♀, ♂; Saldovia, Alaska; on flowers of *Heracleum*].—Ashmead, Proc. Washington Acad. Sci., IV, p. 132, (1902); [Seldovia, Alaska].—Harrington, Ottawa Natural., XV, p. 219, (1902); [Ottawa, Canada].—Viereck, Trans. Amer. Ent. Soc., XXIX, p. 65, (1903); [♂; Beulah, New Mexico].—Rohwer, Proc. U. S. Nat. Mus., LIII, p. 243, (1917); [♀; Tahoe, Eldorado Co., California; elevation, 6200 ft.].

Lectotype.— ♀; Col[orado Territory]. (No other data; but probably taken in the mountain region, the summer of 1864, by James Ridings.) [Academy of Natural Sciences of Philadelphia, Type no. 1911.]

This almost wholly black species may be readily distinguished from its close ally *columbiae* by the features given in the key to species on a preceding page.

Synonymical Notes.—Unfortunately the name *ater* under which this species was known for so long is a homonym; consequently I propose here *Crossocerus* (*Blepharipus*) *pammelas* as a new name to replace *Crabro ater* Cresson, 1865 *nec* Olivier, 1791 (Encycl. Méthod., VI, p. 517).

Distribution.—This is one of the commoner widespread Nearctic species of *Blepharipus*. It is apparently confined largely to the cooler Transition

and Canadian Zones of the eastern and western United States and Canada, and presumably absent from the central Mississippi basin lowlands. Kincaid has reported it from as far north as the Kenai Peninsula in Alaska.

Specimens examined: 26; 21 females, 5 males, as follows:

RHODE ISLAND-CONNECTICUT: South shore of Killingly Pond; (A. B. Klots): 1 ♀.

NEW YORK: New Russia, Essex Co.; August 18, 1912; (J. C. Bradley): 1 ♀. Keene Valley, Essex Co.; August 11, 1917; (H. Notman): 1 ♀. Sphaerium Brook, McLean Reservation, Tompkins Co.; August 19, 1924; 1 ♀. Ithaca, Tompkins Co.; August 22, 1918: 1 ♀. Oliverea, in Catskill Mts., Ulster Co.; September 3–8, 1918: 1 ♀.

NORTH CAROLINA: Black Mts.; June 10–13, 1912; (Wm. Beutenmuller): 1 ♀.

COLORADO: "Mountain region, Colorado Territory; summer, 1864; (James Ridings)"; 2 ♀; [lectotype and paratype; A. N. S. P.].

CALIFORNIA: Giant Forest, Sequoia National Park, Tulare Co.; August 22, 1917; (R. C. Shannon): 2 ♀.

OREGON: Seaside, Clatsop Co.; August 7, 1940; (H. K. & M. Townes): 1 ♀, 1 ♂. Cannon Beach, Clatsop Co.; August 9, 1940; (H. K. & M. Townes): 1 ♀. Mt. Hood: 5 ♀, 1 ♂. Lick Creek Reservation, Wallowa National Forest; elevation, 4600 ft.; August 12–16, 1937; (Bollinger & Jewitt): 1 ♀, 1 ♂.

WASHINGTON: Ashford, Pierce Co.; elevation, 1775 ft.; August 18, 1940; (H. K. & M. Townes): 2 ♂. (No other data): 2 ♀.

BRITISH COLUMBIA: Downie Creek, Selkirk Mts.; Kootenay District; August 8, 1905; (J. C. Bradley): 1 ♂. Vancouver; July 14, 1896; (Livingston): 1 ♀.

Also recorded from: Canada (Ottawa; Quebec). Maine (Brunswick; Mt. Desert Island). New Hampshire. Virginia. California (Tahoe). Washington (Olympia). Alberta (Waterton). Alaska (Seldovia, Kenai Peninsula).

Viereck's record of this species from Beulah, New Mexico, is open to question. It may be the specimen I list under *columbiae* from Daily Canyon near Beulah.

Crossocerus (Blepharipus) columbiae (Bradley), new comb.

Blepharipus columbiae Bradley, Canad. Entom., XXXVI, p. 380, (1906); [♀].

Type.— ♀; Ground Hog Basin, Big Bend Country, Selkirk Mts., British Columbia. July 24, 1905. (J. C. Bradley) [Cornell University.]

The present species, hitherto known only from a unique female, is quite closely related to *pammelas*. The females of *columbiae* have a strong and abruptly elevated, closely punctate, trigonal platform on the disc of the pygidium, with no trace of a carinule such as bisects the more sparsely punctate, tumid pygidial disc of *pammelas*. In the males of the latter species, the fore trochanters, femora and tibiae are all strongly flattened and densely ciliate beneath, whereas in that sex of *columbiae* the fore tibiae and femora are only moderately flattened and are, moreover, glabrous beneath, while the fore trochanters are simply obterete.

Distribution.—This species is apparently confined to the Transition and Canadian Zones of the western, particularly the northwestern, United States and Canadian provinces.

Specimens examined: 14; 4 females, 10 males, as follows:

BRITISH COLUMBIA: Ground Hog Basin, Big Bend country, Selkirk Mts.; July 24, 1905; (J. C. Bradley); 1 ♀; [type]. Rogers Pass; elevation, 4500 ft.; August 1, 1908; (J. C. Bradley):

2 ♀. Carbonate, on Columbia River; elevation, 2600 ft.; July 7–12, 1908; (J. C. Bradley); 1 ♀. Field, Rocky Mts.; elevation, 4800 ft.; July 1, 1908; (J. C. Bradley): 1 ♂. [All Cornell.]

WASHINGTON: Paradise Valley, Mt. Rainier National Park; elevation, 4700 ft.; July 19, 1940; (H. K. & M. Townes): 3 ♂. Reflection Lakes, Mt. Rainer National Park; elevation, 5000 ft.; July 14, 1940; (H. K. & M. Townes): 2 ♂.

OREGON: Cloud Cap Inn, Mt. Hood; elevation, 6–7000 ft.; July 6, 1930; (H. A. Scullen): 1 ♂. Corvallis, Benton Co.; June 1, 1927; (H. A. Scullen): 1 ♂. Alsea, Benton Co.; April 23, 1931; (H. A Scullen): 1 ♂. [All Ore. Agr. Coll.]

NEW MEXICO: Head of Daily Canyon, near Beulah, San Miguel Co.; June 26; (T. D. A. Cockerell): 1 ♂; [A. N. S. P.].

Crossocerus (Blepharipus) stricklandi[14] new species

This Rocky Mountain form is readily distinguished by the peculiar tuberculate character of the male antennal flagellum.

Type.—♂; Jasper, Alberta, Canada. Elevation, 3,470 feet. July 21, 1938. (E. H. Strickland.)

Male. 6 mm. long. Fulgid black; fore and middle tarsi with first two segments eburneous; mandibles dark fulvous on apical half; tibial calcaria fulvous. Wings hyaline, iridescent; veins and stigma brunneous.

Head fulgid; clypeus and front along inner orbits with heavy appressed silvery sericeous pile; vertex and temples with a very sparse clothing of suberect, inconspicuous, light aeneous hair. Front between inner orbits narrow, with a flatly concave, elongate, glabrous, nitidous, immarginate scapal basin, simple and unarmed below; upper horizontal portion of front and vertex with fine well separated setigerous punctures, bisected anteriorly by a weak furrow running forward from anterior ocellus; supra-orbital foveae distinct, elongate-lunate; ocelli large, situated in an equilateral triangle, the postocellar line three-fourths the ocellocular distance; temples perfulgid, with sparse acupuncturation; occipital carina fine. Antennae with scapes slender, cylindrical, ecarinate, almost three-fifths (.59) the vertical eye length; pedicel nitidous, suborcate, two-thirds the length of first flagellar article; flagellum finely puberulent, the segments somewhat rounded out beneath, the first ten medially beneath with a compressed tubercle at apex of which are a number of erect short setulae, first segment one and a half times the length of second, penult segment two-thirds the length of the somewhat compressed, subobacinaciform ultimate article. Clypeus transverse, diamantiform, median length about a third (.353) the vertical eye length, flat laterally to tumid but not keeled discally, median lobe with a glabrous, nitidous welt apically and gently rounded out medially and with a dentiform angle laterally. Mandibles stout; apices bidentate.

Thorax with a sparse and inconspicuous vestiture of short, suberect, light aeneous hair dorsally, the pleura and sterna with a slightly heavier

[14] Dedicated to Prof. E. H. Strickland of the University of Alberta who took the type of this interesting species.

and more noticeable clothing of decumbent silvery pubescence; with fine, sparse and well separated setigerous acupunctures throughout. Pronotum short, transverse, anterior dorsal margin and lateral angles broadly rounded, ecarinate, weakly notched medially, posterior margin strongly impressed. Mesonotum simple, anterior half bisected by a fine impressed double line; suture between mesonotum and scutellum finely consute; axillae, scutellum, and postscutellum simple. Mesopleura with prepectus sharply margined anteriorly; episternal suture straight, foveolate; without a tubercle before middle coxae; hind margin inconspicuously consute; metapleura subglabrous, subnitidous; mesosternum rounded, ecarinate anteriorly. Propodeum perfulgid, with a sparse and inconspicuous vestiture of short, erect, light hairs on posterior face and posterior portion of lateral faces, otherwise glabrous; dorsal face with a trigonal enclosure defined by a coarsely foveolate furrow, anterior margin with a transverse row of foveae, bisected by a strongly marginate and foveolate furrow, the enclosure more or less striate within; posterior face discally with a large, strongly marginate, broad cuneate areole, laterad of which the surface is striate to finely rugulose; lateral carinae weak, developed only below on posterior faces but continued above by a weakly foveate furrow; lateral faces horizontally striate.

For legs simple; tarsi not flattened or distorted. Hind femora subfusiform, without a trenchant edge lengthwise below; hind tibiae rather strongly incrassate apically, outer faces not appreciably spined, the longer calcar one-half the length of the elongate and somewhat swollen hind metatarsi. Middle tibiae with outer faces not appreciably spined, and with one distinct calcar.

Abdomen subfulgid; elongate-subfusiform; thinly clothed with short, decumbent, light aeneous hair. Tergites with a faint transverse aciculation; ultimate tergite trigonal, not more coarsely punctate than preceding tergite, both simple, and without inflexed ventral processes. Apical sternites simple, without tubercles or processes, the hind margins truncate and entire.

Female. Unknown.

Specimens examined.—In addition to the type from Jasper, Alberta, I have studied another male (paratype) taken July 18–31, 1928 by Jos. Bequaert at Granite Peaks Camp, near Bayfield, La Plata Co., Colorado, at an elevation of 9000 feet; and another male (paratype) from Mt. Lemon in the Santa Catalina Mountains, Pima County, Arizona, collected July 27, 1917 by R. C. Shannon.

Crossocerus (Blepharipus) harringtonii (Fox), new comb.

? *Crabro niger* Provancher, Add. & Corr. Faun. Hymen. Canada, p. 419, (1889); [♀; Ottawa, Canada]; [not *Crossocerus niger* Lepeletier & Brullé, 1835].—Fox, Trans. Amer. Ent. Soc., XXII, p. 206, (1895); [not identified].—Gahan & Rohwer, Canad. Entom., XLIX, p. 391, (1917); ["Type.—Female, blue-green label 852 (s), yellow label 1660. 2nd Coll. Pub. Mus., Quebec."]

? *Blepharipus* (*Crabro*) *niger* Harrington, Ottawa Natural., XV, p. 219, (1902); [*niger* Prov. = *harringtonii* Fox.].

Crabro Harringtonii Fox, Trans. Amer. Ent. Soc., XXII, p. 195, (1895); [♀; Ottawa, Canada].—Viereck [in Smith], Insects of New Jersey: Ann. Rept. N. J. St. Mus., 1909, p. 682, (1911); [Trenton, N. J.].

Blepharipus Harringtonii Harrington, Ottawa Natural., XV, p. 219, (1902); [♀; Hull, Canada].

Solenius (*Crossocerus*) *harringtonii* Bradley, Cornell U. Agr. Exp. Sta. Mem. 101, p. 1021, (1928); [New Russia, N. Y.].

Type.—♀; Ottawa, Canada. (Harrington.) [Academy of Natural Sciences of Philadelphia, Type no. 4696.]

This is one of the rarest and most poorly known species of *Blepharipus*. I have seen no males which I believe may be correctly assigned to *harringtonii*.

Harrington has suggested that *Crabro niger* Provancher, 1889, is the correct name for this species. I have not seen Provancher's type of *niger* but inasmuch as there already is a *Crossocerus niger* Lepeletier & Brullé, 1835, Fox's later name *harringtonii* may still be applied to the present species.

Specimens examined: 6 females, as follows:

ONTARIO: Ottawa; (Harrington): 1♀; [type; A. N. S. P.].

NEW YORK: Six Mile Creek, Ithaca, Tompkins Co.; July 4, 1937: 1♀. Van Natta's Dam, Ithaca; July 29, 1936: 1♀. [Cornell.]

PENNSYLVANIA: Montgomery Co.; July 4, 1910: 1♀; [A. N. S. P.].

NEW MEXICO: Little Tesuque Canyon, vicinity of Santa Fé; July 27–August 10, 1932; (A. B. Klots); 1♀.

ALBERTA: Wabamun; June 28, 1936; (E. H. Strickland): 1♀; [U. Alta.]

This species has also been recorded from Trenton, New Jersey.

Crossocerus (Blepharipus) cinctipes (Provancher), new comb.

Blepharipus cinctipes Provancher, Natural. Canad., XIII, p. 133, (1882); [♂; Petit Cap, S. Joachim, Quebec].—Provancher, Faun. ent. Canad., Hymen., p. 667, (1883).—Ashmead, Canad. Entom., XXXI, p. 217, (1899).—Harrington, Ottawa Natural., XV, p. 219, (1902); [♀, ♂; Ottawa, Canada].—Gahan & Rohwer, Canad. Entom., XLIX, p. 333, (1917); ["Type.—Male, yellow label 957. 2nd Coll. Pub. Mus., Quebec."]

Crabro cinctipes Cresson, Trans. Amer. Ent. Soc., Suppl. vol., p. 284, (1887); [♂; Canada].—Fox, Trans. Amer. Ent. Soc., XXII, p. 197, (1895); [♀, ♂; Canada].

Crabro (*Crossocerus*) *cinctipes* Brimley, Ins. North Carolina, p. 450, (1938); [Raleigh, N. C.].

Crabro nigror Fox, Trans. Amer. Ent. Soc., XXII, p. 196, (1895); [♀; New Hampshire].—Fox, Trans. Amer. Ent. Soc., XXIII, p. 80, (1896); [*nigror* Fox emended to *nigrior*].—Cresson, Amer. Ent. Soc. Mem., no. 5, p. 54, (1928).

Type.—♂; Petit Cap, S. Joachim, Quebec, Canada. [Museum of Natural History, Department of Public Instruction, Parliamentary Building, Quebec.]

This is the only Nearctic *Blepharipus* with a coarsely sculptured and areolate propodeum. The other important diagnosis attributes of *cinctipes* are given in the key to species on a preceding page.

Synonymical Notes.—I have examined the type of *Crabro nigror* Fox (in the collection of the Academy of Natural Sciences of Philadelphia), and have been unable to find any appreciable difference between it and the specimens Fox determined as *cinctipes* Provancher. Until further data are

forthcoming, I shall regard *nigror* Fox, 1895 as a synonym of *cinctipes* Provancher, 1882.

Distribution.—This species is primarily an inhabitant of the Transition and Upper Austral Zones of northeastern North America.

Specimens Examined: 15; 2 males, 13 females, as follows:

CANADA: 1 ♀, 1 ♂: (no other data, but probably Ottawa); [A. N. S. P.].
VERMONT: Chittenden, Rutland Co.; August 1–15, 1916: 10 ♀.
NEW YORK: Mt. Skylight, Essex Co.; elevation, 4800–4920 ft.; August 22, 1920; 1 ♂. Ithaca, Tompkins Co.; June 17, 1930: 1 ♀.
NEW JERSEY: Chatsworth, Burlington Co.; June 15, 1923; (J. C. Bradley): 1 ♀.
Also recorded from: Ontario (Ottawa). Quebec (Petit Cap, S. Joachim; the type). North Carolina (Raleigh).

Crossocerus (Blepharipus) stictochilos[15] new species

The nearest relative of *stictochilos* is the following form *nigricornis*, from which it is separable by a number of features given in the key to species on a preceding page.

Type.— ♀; Medford Lakes, Burlington County, New Jersey. August 26, 1936. (V. S. L. Pate; at flowers of *Clethra alnifolia*.)

Female. 7 mm. long. Black; the following light stramineous: scapes anteriorly, clypeus with a small spot along each lower inner orbit, pronotum with a small spot on each side of dorsal face, pronotal tubercles, all tibiae with a longitudinal stripe on outer faces, and all metatarsi. Mandibles dark fulvous. Tegulae and axillary sclerites brunneous. Wings hyaline, iridescent; veins and stigma brunneous.

Head more or less fulgid; clypeus and front along inner orbits with appressed, silvery sericeous pile; vertex thinly clad with short, suberect, inconspicuous light pubescence; temples with a moderate clothing of decumbent short silvery hair. Front between inner orbits very narrow, with a flatly concave, elongate, glabrous and nitidous, immarginate scapal basin, simple and unarmed below; upper horizontal portion of front and vertex with moderately fine and close but distinct setigerous puncturation, bisected anteriorly by a strong furrow running forward from anterior ocellus; supra-orbital foveae large, distinct, arcuate-cuneate; ocelli large, situated in an equilateral triangle, the postocellar line four-fifths the ocellocular distance; temples fulgid, more finely and sparsely punctate than vertex; occipital carina moderate, finely consute anteriorly. Antennae with scapes straight, cylindrical, ecarinate, three-fifths the vertical eye length; pedicel subcylindrical, three-fourths the length of first flagellar article; flagellum simple, finely puberulent, first segment four-thirds the length of second, ultimate article simple, terete, one and three-fourths the length of penult segment. Clypeus transverse, median length one-fourth the vertical eye length; flat and attenuate laterally to weakly tectate (but not keeled)

[15] From στικτός, spotted+χεῖλος, lip; in allusion to the spotted clypeus.

discally, produced medially into a short, broad, subtruncate lobe, the apical width of which is four-fifths the median clypeal length, apical margin of lobe tricrenulate, laterally on each side of lobe and separated from it by a rounded emargination with a dentiform angle. Mandibles stout; apices tridentate; lower margins simple; inner margins edentate.

Thorax more or less fulgid; dorsally with a thin vestiture of short, erect, subaeneous hair; pleura and sterna with a heavier and more noticeable clothing of appressed silvery pubescence. Pronotum short, transverse, dorsal face tumid, without transverse furrow, rounded and ecarinate anteriorly, lateral angles rounded and without vertical carina, posterior margin impressed. Mesonotum with distinct, moderately close punctuation throughout, anterior half bisected by a longitudinal furrow at base of which lies a longitudinal carinule; suture between mesonotum and scutellum finely foveolate; scutellum flatly tumid, punctured like mesonotum; postscutellum simple. Mesopleura finely punctate throughout; prepectus sharply margined anteriorly; episternal suture coarsely foveate; a small but distinct tubercle before middle coxae; mesopleural pit distinct; posterior margin finely and indistinctly foveolate; metapleura glabrous, nitidous, posterior margin coarsely foveate; mesosternum rounded, ecarinate anteriorly. Propodeum on dorsal face with a glabrous, nitidous, perfulgid trigonal enclosure delimited posteriorly by a foveolate furrow, the anterior margin finely foveolate, and bisected by a strongly marginate obterete furrow, weakly foveate within; posterior face with a moderate vestiture of erect, silvery hair, bisected by a elongate immarginate fovea, laterad of which the surface is finely punctate; lateral carinae present and well developed along posterior face, obsolescent along dorsal face where their place is taken by a shallow weakly foveate furrow extending to the tubercles; lateral faces glabrous, subnitidous.

Legs simple: fore tarsi neither flattened nor with a pecten; middle and hind tibiae obterete, moderately spinose on outer faces; longer hind tibial calcar three-fourths the length of hind metatarsi; hind femora rounded beneath, without a trenchant edge lengthwise below.

Abdomen fusiform, not perceptibly punctate; first tergite glabrous, nitidous, the remainder with a fine vestiture of decumbent, puberulent, light hair. Pygidium strongly narrowed and excavate apically, the disc rather abruptly elevated at base into a flat, closely punctate, trigonal platform from the apex of which is emitted a short carinule. Sternites subglabrous, subnitidous.

Allotype.—♂; Great Falls, Fairfax County, Virginia. June 25. (Nathan Banks.) [Museum of Comparative Zoölogy.]

Male. 6.5 mm. long. Agrees with the female (type) except in the following details:

Livery the same but femora and tibiae fulvous beneath.

Head with furrow bisecting upper front weaker; vertex with punctures more distinct and more widely separated; supra-orbital foveae small, rather indistinct, obpyriform and oblique in position; postocellar line three-fourths the ocellocular distance. Antennal scape one-half the vertical eye length; pedicel suborcate, one-half the length of first flagellar article; flagellum simple, the segments fringed beneath with conspicuous white hair, first article four-thirds the length of second, ultimate article simple, terete, one and three-fourths the length of penult segment. Clypeus with median length almost three-tenths (.28) the vertical eye length, the lobe tricrenulate at apex, the middle tooth the most prominent. Mandibles bidentate at apex.

Thorax with bisecting furrow and carinule of mesonotum fainter and more indistinct. Mesopleura with tubercle before middle coxae indistinct. Propodeum on dorsal face with bisecting furrow strongly foveate within.

Legs with fore femora and tibiae not explanate but somewhat flattened beneath and with a moderate vestiture of hair there. All tarsi simple. Longer hind tibial calcar six-tenths the length of hind metatarsi which are subequal in length to four distal segments combined.

Abdomen about as in female but last tergite without a pygidium, no more coarsely punctate than penult tergite, and with inflexed ventral prongs overlying the base of seventh sternite, the disc of which is furnished with a large Y-shaped tubercle.

Specimens examined.—In addition to the types, I have examined a female (paratype) taken by J. C. Bradley, September 30, 1931, at Millville, Cumberland County, New Jersey. This paratype agrees with the type in all essential details of livery and structure.

Crossocerus (Blepharipus) nigricornis (Provancher), new comb.

Blepharipus nigricornis Provancher, Add. Faun. Hymen. Canada, p. 294, (1889); [♂; Cap Rouge, Quebec].—Ashmead, Canad. Entom., XXXI, p. 217, (1899).—Harrington, Ottawa Natural., XV, p. 219, (1902); [♂, ♀; Ottawa, Canada].—Gahan & Rohwer, Canad. Entom., XLIX, p. 333, (1917); ["Type.—Male, yellow label 1448. 2nd Coll. Pub. Mus., Quebec."].

Crabro nigricornis Fox, Trans. Amer. Ent. Soc., XXII, p. 195, (1895); [♀, ♂; Canada; Montana; Virginia].

Crabro (*Blepharipus*) *nigricornis* Rohwer, Ent. News, XIX, p. 246, (1908); [♀; Copeland Park, Boulder Co., Colorado; alt. 8500 ft.].—Mickel, Univ. Nebr. Stud., XVII, p. 382, (1918); [♀; Monroe Canyon, Sioux Co., Nebraska].

Crabro (*Crossocerus*) *nigricornis* Brimley, Ins. North Carolina, p. 450, (1938); [Blowing Rock, North Carolina].

Solenius (*Crossocerus*) *nigricornis* Bradley, Cornell U. Agr. Exp. Sta. Mem. 101, p. 1021, (1928); [New York: Ithaca; McLean Bogs; Gardiner's I.].

Type.—♂; Cap Rouge, Quebec, Canada. [Museum of Natural History, Department of Public Instruction, Parliamentary Building, Quebec.]

The diagnostic features of this species have been presented in the key to species on a preceding page.

Ethology.—In the Cornell University collection are two elder stems collected the fall of 1884 by Professor Comstock who kept them in a warm

room throughout the winter and from which emerged May 13, 1885, several adult *nigricornis* of both sexes. The nests of these *nigricornis* are excavated from the pithy centers of the elder stems and are in the form of a straight tunnel. In each case, the tunnel is separated into several cells by plugs of triturated pith. The cells still contain fragments of a variety of flies, particularly Empidids and Dolichopodids, but the remains of quite a few other Diptera (Muscidae, Anthomyiidae, Ceratopogonidae, and various acalyptrates) are present.

Distribution.—This is undoubtedly the commonest Nearctic *Blepharipus* ranging throughout the Transition and Upper Austral Zones of eastern and western North America. It is still unknown from the central Mississippi lowland basin.

Specimens Examined: 40; 21 males, 19 females, 1 gynandromorph, as follows:

QUEBEC: Montreal; June 12–July 10, 1902: 4♂, 1♀.
ONTARIO: Waubanic, on Parry Sound; June 16, 1915; (H. S. Parrish): 1♂.
VERMONT: Chittenden, Rutland Co.; August 1–15, 1916; 1♂, 3♀.
NEW YORK: Upper Ausable, Essex Co.; July 18, 1920: 1♀. Taughanic Falls, Tompkins Co.; August 25: 1♀. McLean Bogs, Tompkins Co.; May 29, 1915: 1♂. Van Natta's Dam, Ithaca, Tompkins Co.; August 18, 1936: 1♂. Ithaca, Tompkins Co.; June 17–July 30: 3♂, 1♀; also (J. H. Comstock; bred from nests in elder stems: adults emerged, May 13, 1885): 3♂, 1♀.
PENNSYLVANIA: Arendtsville, Adams Co.; July 21, 1928; (S. W. Frost): 1♂.
MONTANA: Glacier National Park; July 30, 1930; (E. T. Cresson): 1♂. (No other data): 1♂, 1♀.
ALBERTA: Medicine Hat; July 7, 1938; (E. H. Strickland): 1♀. Elk Island; June 3, 1939; (E. H. Strickland): 1♀. Waterton; July 3, 1923; (E. H. Strickland): 1♀. Edmonton; July 20, 1929; (E. H. Strickland): 1♀. Wabamun; July 22, 1936; (E. H. Strickland): 1 gynandromorph.
BRITISH COLUMBIA: Rogers Pass; August 1, 1908; (J. C. Bradley): 1♀.
WASHINGTON: Seattle, King Co.; June 24, 1897; (Trevor Kincaid): 1♂. Ashford, Pierce Co.; elevation, 1775 ft.; (H. K. & M. Townes): 2♀.
OREGON: Seaside, Clatsop Co.; August 7, 1940; (H. K. & M. Townes); 1♀. Mt. Hood: 3♂. Cascadia, Linn Co.; May 19, 1935; (H. A. Scullen): 1♂.
Also recorded from: Virginia. North Carolina (Blowing Rock). Nebraska (Monroe Canyon, Sioux Co.). Colorado (Copeland Park, Boulder Co.; elevation, 8500 ft.).

Crossocerus (Blepharipus) fergusoni* new species

The present species has the superficial habitus of *nigricornis* but is more closely related to the eastern *impressifrons* with which it agrees in the strongly flattened fore trochanters, femora and tibiae, densely hirsute beneath and the brush of hair clothing the thoracic sterna. But *fergusoni* is almost wholly black; it lacks the bright yellow maculations so characteristic of *impressifrons*. Moreover, in *fergusoni* the inflexed ventral processes of the ultimate abdominal tergite are simple and flat at the apex and the seventh sternite has merely a low trigonal platform at base with a low and indistinct keel bisecting the disc, whereas in both *impressifrons* and

* Dedicated to Dr. George Ferguson of Corvallis, Oregon, who took the type of this interesting species.

nigricornis the inflexed processes are strongly clubbed at apex and flattened and concave caudally, while the disc of the seventh sternite is bisected by a rather high subcristate keel emitted from a high trigonal basal platform. The shaggy lower temporal and gular regions readily differentiate *fergusoni* from all its near relatives.

Type.—♂; Rickreall, Polk County, Oregon. July 5, 1936. (George Ferguson.)

Male. 6.5 mm. long. Perfulgid black; the following dilute croceous: antennal scapes with a broad longitudinal stripe on outer posterior faces, fore tibiae with a longitudinal stripe on outer faces, fore femora beneath, middle tibiae with a short stripe at knees, middle femora with an obscure stripe along posterior faces. Tibial calcaria testaceous. Wings clear hyaline, iridescent; veins and stigma brunneous.

Head with clypeus entirely and front narrowly along lower inner orbits with moderately heavy, appressed, silvery sericeous pile; vertex and upper temples with a thin vestiture of erect, long, light hair; lower temples and gular region with a rather dense brush of pendant long white hair. Front narrow between inner orbits and with a flatly concave, elongate, glabrous, nitidous, immarginate scapal basin, simple and unarmed below; upper horizontal portion of front and vertex with fine, very well separated, setigerous acupunctures, bisected anteriorly by a sharp furrow running forward from median ocellus; supra-orbital foveae sharp, distinct, elongate-cuneate; postocellar line three-fourths the ocellocular distance; temples with fine, sparse, well separated, setigerous acupunctures; occipital carina distinct. Antennae with scapes slender, cylindrical, ecarinate, almost three-fifths (.59) the vertical eye length; pedicel obterete, two-thirds the length of first flagellar article; flagellum simple, finely puberulent, with a rather heavy fringe of erect, long hairs beneath, first two segments subequal in length, last article simple, terete, one and a half times as long as penult segment. Clypeus transverse, diamantiform, medially three-tenths the vertical eye length; flat laterally to strongly keeled and tectate discally, median lobe strongly tricrenulate apically, the median tooth very large and distinct. Mandibles stout; apices evenly bidentate; inner margins edentate.

Thorax perfulgid; dorsum and pleura with a moderate vestiture of erect, rather long, light hair; sternum with a moderately dense brush of conspicuous white hair; with fine, sparse, and well separated setigerous acupunctures throughout. Pronotum short, transverse, anterior dorsal margin rounded, ecarinate, lateral angles bluntly subtuberculate, not notched medio-dorsally, posterior margin strongly impressed. Mesonotum simple, anterior half bisected by a fine line; suture between mesonotum impressed and finely consute; axillae, scutellum and postscutellum simple. Mesopleura with prepectus sharply margined anteriorly; episternal suture slight-

ly sinuous, foveolate; without a tubercle before middle coxae; mesopleural pit small, inconspicuous; hind margin simple; metapleura glabrous, nitidous. Propodeum perfulgid; posterior face and lateral areas of dorsal face with a thin vestiture of suberect light hair, otherwise glabrous; dorsal face with a moderately well defined, glabrous, nitidous, trigonal area, anterior margin foveolate, bisected by a narrow, strongly marginate, furrow, inconspicuously foveolate within, and terminating posteriorly in the narrow sharply impressed but immaginate furrow bisecting the posterior face, the lateral areas very sparsely acupunctate; lateral carinae rather well developed below but becoming weak above, paralleled by a shallow, weakly foveolate sulcus; lateral faces glabrous, nitidous.

Fore legs with the trochanters slightly, the femora and tibiae strongly flattened beneath, and the tarsi simple, neither flattened nor distorted, all provided with a dense brush of white hair beneath. Middle legs simple. Hind legs with femora with a sharp trenchant edge lengthwise below; tibiae strongly clavate apically, their outer faces with a few weak spines; longer tibial calcar flattened, broadly lanceolate, and one-half the length of the slightly thickened metatarsi.

Abdomen fulgid; elongate-subfusiform; thinly clothed with short, decumbent, light aeneous hair. Tergites with a faint transverse aciculation; ultimate tergite elongate trigonal, no more coarsely punctate than penult tergite, and with inflexed ventral prongs which are rather slender, flat, and simple, not clubbed, at apex. Seventh sternite mediobasally with a low, flat, trigonal platform from apex of which is emitted a short, weak keel; apical margin broadly and shallowly retuse. Hypopygium flat, apex broadly shallowly retuse.

This melanic form of the Pacific northwest is known only from the unique male described above.

Crossocerus (Blepharipus) impressifrons (F. Smith), new comb.

Crabro tibialis Say [in Keating], Long's Exped. St. Peter's R., App., II, p. 340, (1824); [♀; Pennsylvania]; (not Gmelin, 1790; Olivier, 1791; nor Fabricius, 1798).—Leconte, Writ. Say, Entom., I, p. 230, (1859).

Crabro impressifrons F. Smith, Cat. Hymen. Brit. Mus., IV, p. 417, (1856); [Penna.]; (new name for *tibialis* Say, 1824).—Cresson, Trans. Amer. Ent. Soc., Suppl. vol., p. 285, (1887); [Mass.; N. Y.; Ill.].—Fox, Trans. Amer. Ent. Soc., XXII, p. 194, (1895); [♀, ♂; Mass.; N. Y.; Ill.]

Blepharipus impressifrons Packard, Proc. Ent. Soc. Phila., VI, p. 374, (1867); [♀; N. Y.; Cambridge, Mass.].—Ashmead, Canad. Entom., XXXI, p. 217, (1899).—Harrington, Ottawa Natural., XV, p. 219, (1902); [♀, ♂; Ottawa, Canada].

Blepharipus scutellatus Packard, Proc. Ent. Soc. Phila., VI, p. 375, (1867); [♂; N. Y.; Mass.]; (not Say, 1824).

Crabro (*Blepharipus*) *impressifrons* Viereck [in Smith], Ins. New Jersey: Ann. Rept. N. J. St. Mus., 1909, p. 682, (1911); [Riverton, N. J.].—Mickel, Univ. Nebr. Stud., XVII, p. 382, (1918); [♀, ♂; Nebraska: Omaha; Falls City].

Crabro (*Crossocerus*) *impressifrons* Brimley, Ins. North Carolina, p. 450, (1938); [North Carolina: Edgecombe Co.; Raleigh].

Solenius (*Crossocerus*) *impressifrons* Bradley, Cornell Univ. Agr. Exp. Sta. Mem. 101, p. 1021, (1928); [New Russia, N. Y.].

Crabro (Blepharipus) tridentatus Rohwer, Ent. News, XX, p. 150, (1909); [♀, ♂; Falls Church, Va.; Washington, D. C.]; (not Fabricius, 1775, nor Smith, 1868).

Type.— ♀ ; Pennsylvania. [Probably Philadelphia or the vicinity.[16]]

The bright yellow scutellum, pronotum, legs and antennal scapes immediately distinguish *impressifrons* from its Nearctic congeners. The other North American species of *Blepharipus* are never as extensively maculated as *impressifrons*, and their colour markings, moreover, are white or at most very pale yellow.

Synonymical Notes.—I have examined the lectotype of *Crabro (Blepharipus) tridentatus* Rohwer, 1909 (*nec* Fabricius, 1775, *nec* Smith, 1868), a female from Falls Church, Virginia, in the collection of the Museum of Comparative Zoölogy at Cambridge, and find that it agrees in all essential respects with the modern interpretation of the present species. Rohwer's species is accordingly recorded here as a synonym of *impressifrons*.

Distribution.—This is one of the commonest species of *Blepharipus* of the Upper Austral and Transition Zones of the eastern United States and Canada.

Specimens Examined: 19; 14 females, 4 males, as follows:

NEW YORK: New Russia, Essex Co.; August 18, 1922; (J. C. Bradley): 1 ♀. Penn Yan, Yates Co.; July 19, 1935; 1 ♀. Ithaca, Tompkins Co.; July 9–August 27: 1♂, 2 ♀.

RHODE ISLAND: Newport; (Leidy); 1 ♀ ; [A. N. S. P.].

NEW JERSEY: Greenwood Lake, Passaic Co.; August 20, 1916; 1 ♀.

PENNSYLVANIA: Delaware County; May 16, 1905; 1♂; [A. N. S. P.]. New Cumberland, Cumberland Co.; (Kirk & Chamberlain; bred specimens, emerged March 17, 1909): 1♂, 1 ♀; [A. N. S. P.]

MARYLAND: Plummer's Island; July 4, 1921: 1 ♀.

VIRGINIA: Falls Church, Fairfax Co.; June 10–16; (Nathan Banks): 2 ♀ ; [lectotype and paratype of *Crabro (Blepharipus) tridentatus* Rohwer; M. C. Z.].

NORTH CAROLINA: 1 ♀ ; (no other data); [A. N. S. P.].

OHIO: Put-in-Bay, Ottawa Co.; July 6, 1922; 1 ♀ ; [O. S. U.].

GEORGIA: Billys Island, Okefenokee Swamp; June, 1912; 1♂.

ILLINOIS: Algonquin, McHenry Co.; (Nason): 1♂, 1 ♀ ; [A. N. S. P.]. 1 ♀ ; (no other data); [A. N. S. P.].

Also recorded from: Canada (Ottawa). Massachusetts (Cambridge). New Jersey (Riverton). Washington, D. C. North Carolina (Raleigh and Edgecombe Co.). Nebraska (Omaha and Falls City).

Crossocerus (Blepharipus) tarsalis (Fox), new comb.

Crabro tarsalis Fox, Trans. Amer. Ent. Soc., XXII, p. 193, (1895); [♂; New York]; (not Stephens, 1829, a nomen nudum).—Kincaid, Ent. News, XI, p. 359, (1900); [♂; Seattle, Washington]. —Krombein, Bull. Brooklyn Ent. Soc., XXXIV, p. 144, (1939); [Millwood, N. Y.].
Stenocrabro tarsalis Ashmead, Canad. Entom., XXXI, p. 217, (1899); [♂].

Type.—♂; New York. (No other data.) [Academy of Natural Sciences of Philadelphia, Type no. 4695.]

[16] Say states this is " . . . A small species in the collection of Mr. William W. Wood." The fate of the collection of Wood, who was a stationer of 88 Walnut St., Philadelphia, is unknown The type is quite probably no longer extant.

The spirally distorted male fore tarsi and, in both sexes, the sharp vertical carina at the lateral angles of the pronotum readily differentiate *tarsalis* from all other Nearctic *Blepharipus*.

In 1895 Fox associated *tarsalis* with *planipes*, placing both in his eighteenth species group of *Crabro*. Three years later Ashmead when he based *Stenocrabro* on *planipes*, followed Fox by including *tarsalis* in that genus. But a study of the females of *tarsalis* and *planipes*, both of which have hitherto been unknown, proves conclusively, as a careful examination of the males will likewise reveal, that neither species has anything in common with the other: *tarsalis* is indubitably a *Blepharipus* and *planipes* a *Crossocerus* or *Stenocrabro*.

The *Crabro tarsalis* of Stephens, 1829 is a nomen nudum and consequently will not preoccupy *Crabro tarsalis* Fox, 1895.

Distribution. This is a relatively common species throughout the Transition Zone of northeastern North America. I have seen but one specimen from the Pacific northwest (Seattle, Washington), but the species will probably eventually be found well distributed throughout that area.

Specimens Examined: 19; 8 males, 11 females, as follows:

QUEBEC: St. Hilaire; July 28, 1927; (J. W. Buckle); 1 ♀. Shawbridge; July 1, 1929; (J. W. Buckle); 1 ♀.

VERMONT: Chittenden, Rutland Co.; August 1–15, 1916: 1 ♂.

MASSACHUSETTS: North Reading; June 10; (C. W. Johnson): 1 ♀. Blue Hills Reservoir; 1 ♂. Stony Brook Reservoir; June 14–July 12, 1925; 1 ♂, 1 ♀. Lexington; July 27, 1919; 1 ♀.

NEW YORK: Duck Lake, Conquest, Cayuga Co.; August 5, 1921; (R. C. Shannon); 1 ♂. Trumbull Corner, Connecticut Hill, Tompkins Co.; elevation, 2095 ft.; July 7, 1937; 1 ♀. Ithaca, Tompkins Co.; June 16, 1936: 1 ♀. Cold Spring Harbor, Suffolk Co.; August 9, 1920: 1 ♀. Gardiner's Island, Suffolk Co.; August 17–23, 1918; 1 ♂. (No other data): 1 ♂; [type; A. N. S. P.].

NEW JERSEY: Ramsey, Bergen Co.; June 6, 1916; 1 ♂. Palisades, Bergen Co.; July 4, 1920; 1 ♀. Lahaway, Ocean Co.; 1 ♀.

WASHINGTON: Seattle, King Co.; July 26, 1898; (Trevor Kincaid); 1 ♂.

SPECIES IGNOTAE

The following two species are probably referable to the subgenus *Blepharipus*, but the original descriptions are too unsatisfactory for me to place them further without an examination of the types which are in the collection of the University of Nebraska. Each form is apparently still known only from a unique female. According to Mickel, both have the clypeus weakly tectate, the clypeal lobe truncate apically, and the mesopleura armed with a small tubercle before the middle coxae.

CROSSOCERUS (BLEPHARIPUS) UTENSIS (Mickel)

Thyreopus (*Blepharipus*) *utensis* Michel, Trans. Amer. Ent. Soc., XLII, p. 421, (1916); [♀; Ute Creek, Colorado].

Mickel states this species is closely related to *ater* (i.e. *pammelas*), but differs from it in the puncturation of the head and thorax and the sculptur-

ing of the propodeum. Both of these features, however, are unreliable criteria for specific differentiation in *Blepharipus*, but inasmuch as the mesopleura are said to be furnished with a small tubercle before the middle coxae, there is a possibility that *utensis* is a valid form since the mesopleura of *pammelas* are unarmed.

CROSSOCERUS (BLEPHARIPUS) STYGIUS (Mickel)

Thyreopus (Subgenus?) *stygius* Michel, Trans. Amer. Ent. Soc., XLII, p. 422, (1916); [♀; Bad Lands at mouth of Monroe Canyon, Sioux Co.; Nebraska; at flowers of *Astragalus*].

The description of this species agrees tolerably well with what I consider the female of *cinctipes*, and, inasmuch as Mickel states *stygius* is closely related to *nigrior* Fox, considered here a synonym of *cinctipes* Provancher, it is possible that *stygius* is a synonym of Provancher's species.

Subgenus ACANTHOCRABRO Perkins

Blepharipus Lepeletier & Brullé, Ann. Soc. Ent. France, III, p. 728, (1835); [in part].
Crabro (*Crossocerus*) Wesmael, Bull. Acad. R. Sci. Belg., XIX, p. 594, (1852); [in part].
Crabro (*Blepharipus*) A. Morawitz, Bull. Acad. Sci. St. Petersbourg, VII, p. 457, (1864).—Thomson, Hymen. Scand., III, p. 279, (1874); [in part].—Berland, Faune de France, X, p. 188, (1925).
Crabro (*Cuphopterus*) Schmiedeknecht, Hymen. N. u. Mitteleurop., Zw. Aufl., p. 648, (1930); [in part].—Hedicke, Brohmer's Tierwelt Mitteleurop., V: 2, p. 126, (1930); [in part].
Crabro (Haupt-Artengruppe *Crabro:* Artengruppe *Cuphopterus* A. Morawitz: Untergruppe: *Crabro vagabundus* Panzer) Kohl, Ann. K. K. Naturhist. Hofmus. Wien, XI, p. 492, (1896).
Crabro (Artengruppe *Crossocerus:* Untergruppe *Blepharipus* A. Morawitz) Kohl, Ann. K. K. Naturhist. Hofmus. Wien, XXIX, pp. 195, 215, (1915).
Acanthocrabro Perkins, Trans. Ent. Soc. London, pp. 391, 395, (1913).—Richards, Gen. Names Brit. Ins., pt. 5, Hymen, Acul., pp. 106, 133, (1937).
Crabro (*Crossocerus Acanthocrabro*) Pate, Amer. Ent. Soc. Mem. no. 9, p. 5, (1937).

GENOTYPE: *Crabro vagabundus* Panzer, 1798 [=*Crossocerus* (*Acanthocrabro*) *vagabundus* (Panzer)]. (Monobasic.)

This small Old World group evidently represents the ancestral stock from which both *Cuphopterus* and *Nothocrabro* have arisen. The distinctive features of *Acanthocrabro* have been presented in the tabular conspectus of the subgenera.

Nomenclatorial Remarks.—Like *Cuphopterus*, the present group has led a checkered career. Morawitz suggested in 1864 that Lepeletier and Brullé evidently had *vagabundus* in mind as a typical example of *Blepharipus*, But inasmuch as Ashmead validly designated *nigrita* type of *Blepharipus*, the latter name is correctly applied to the group which some authors still call *Coelocrabro* Thomson.

Ethology.—The species of *Acanthocrabro* are xylicolous, nesting in small holes in old tree trunks and fence posts. The cells are provisioned with small Tipulids of the genera *Tipula*, *Nephrotoma*, *Trimicra* and *Pachyrrhina*.

Distribution.—The subgenus *Acanthocrabro* is confined wholly to the Old World and chiefly to the Palaearctic Region.

Subgenus CUPHOPTERUS A. Morawitz

Blepharipus Lepeletier & Brullé, Ann. Soc. Ent. France, III, p. 728, (1935); [in part].—Richards, Trans. R. Ent. Soc. London, LXXXIII, p. 167, (1935); Gen. Names Brit. Ins., pt. 5, Hymen. Acul., pp. 106, 133, (1937).

Crabro (*Blepharipus*) Wesmael, Bull. Acad. R. Sci. Belg., XIX, p. 594, (1852).—Thomson, Hymen. Scand., III, p. 278, (1874); [in part].

Crabro (*Cuphopterus*) A. Morawitz, Bull. Acad. Sci. St. Petersbourg, IX, p. 252, (1866).—Berland, Faune de France, X, p. 187, (1925).—Schmiedeknecht, Hymen. N. u. Mitteleurop., Zw. Aufl., p. 648, (1930); [in part].—Hedicke, Brohmer's Tierwelt Mitteleurop., V: 2, p. 126, (1930); [in part].

Cuphopterus Ashmead, Canad. Entom., XXXI, p. 216, (1899).—Perkins, Trans. Ent. Soc. London, 1913, p. 391, 395, (1913).

Crabro (Haupt-Artengruppe *Crabro:* Artengruppe *Cuphopterus* A. Morawitz: Untergruppe: *Crabro signatus-serripes* Panzer) Kohl, Ann. K. K. Naturhist. Hofmus. Wien, XI, p. 492, (1896).

Crabro (Artengruppe *Crossocerus:* Untergruppe *Cuphopterus* A. Morawitz) Kohl, Ann. K. K. Naturhist. Hofmus. Wien, XXIX, pp. 195, 210–215, (1915).

Crabro (*Crossocerus Cuphopterus*) Pate, Amer. Ent. Soc. Mem. no. 9, p. 20, (1937).

GENOTYPE: *Crabro* (*Blepharipus*) *subulatus* Dahlbom, 1845 [=*Crabro* (*Blepharipus*) *monstrosus* Herrich-Schaeffer, 1845 [in Dahlbom]=*Crossocerus* (*Cuphopterus*) *monstrosus* (Herrich-Schaeffer)]. (Monobasic, and by designation of Ashmead, 1899, Canad. Entom., XXXI, p. 216).

The subgenus *Cuphopterus*, as here understood, agrees with the definition which Kohl gave in 1915 of the "Untergruppe *Cuphopterus* A. Morawitz" except that the abdomen may be either black maculated with yellow, immaculate black, or red and black.

Nomenclatorial Remarks.—Lepeletier and Brullé placed a rather miscellaneous assortment of species in their genus *Blepharipus*. In 1852 Wesmael restricted the name *Blepharipus* to include merely the species *signatus* and *serripes*. But Morawitz later disagreed with this restriction, calling attention to the fact that of the nine species originally placed in *Blepharipus* only *Crabro vagabundus* agreed with the statement of Lepeletier and Brullé in their generic diagnosis that " . . . ♂. Cuisses antérieures munies d'une dent à leur partie inférieure vers le milieu." For *Blepharipus* in the sense of Wesmael, Morawitz consequently proposed the name *Cuphopterus*, and most subsequent authors have followed him by employing *Cuphopterus* for the present subgenus. But recently Richards, under the misimpression that Westwood's citation in 1839 of *Crabro dimidiata* Fabricius as an example of *Blepharipus* constituted a valid type fixation for that generic name, has reapplied *Blepharipus* to the *dimidiatus-confusus* group (olim *signatus* and *serripes* respectively). However, I prefer to follow Kohl who, in 1896 and later in his classic monograph of 1915, employed *Cuphopterus* for the present group, particularly inasmuch as this usage is nomenclatorially correct.

Ethology.—The species of *Cuphopterus* nest in rotten tree stumps, very hard rotten wood, and even in shelf fungi of the genus *Polyporus*.[17] The

[17] *Cf.:* Hamm & Richards, 1926, Trans. Ent. Soc. London, pp. 316–317, 328.

cells are provisioned with a variety of flies (Muscidae, Scatophagidae, Therevidae, Dolichopodidae, Rhagionidae, Stratiomyiidae). The biology of this group was unknown to Minkiewicz who, on the basis of the shape of the female pygidium, placed *Cuphopterus* in his Planicrabronid-Chthonocrabronid division and predicted that the component species would eventually be found to be terricolous.[18]

Distribution.—The subgenus *Cuphopterus* is confined to the Old World, with representatives in the Palaearctic, Oriental and Ethiopian Regions.

Nothocrabro new subgenus

Crabro (13. Group *nitidiventris*) Fox, Trans. Amer. Ent. Soc., XXII, p. 180, (1895); (in part).
Cuphopterus Ashmead, Canad. Entom., XXXI, p. 217, (1899); (in part, not of Morawitz).

GENOTYPE: *Crabo nitidiventris* Fox, 1895 [=*Crossocerus* (*Nothocrabro*) *nitidiventris* (Fox)].

The present subgenus displays a curious blend of the characteristics of *Cuphopterus*, *Acanthocrabro* and *Stictoptila*, but is discrete from each. From the last, *Nothocrabro* is distinguished by the different mandibular dentition and the simple etuberculate mesopleura, and from *Cuphopterus* and *Acanthocrabro* by the strongly, spirally distorted fore tarsi of the male and the strongly narrowed and excavate pygidium of the female. The remaining features differentiating this New World complex from the Old World subgenera *Cuphopterus* and *Acanthocrabro* have been presented in the tabular conspectus on a preceding page.

Diagnostic Features.—Moderate sized, fulgid, finely punctate, black forms well maculated with yellow. Head subquadrate in anterior aspect, broadly subrectangular in dorsal aspect. Front simple, unarmed below; upper horizontal portion on same plane as vertex, bisected anteriorly by a furrow running forward from median ocellus; supra-orbital foveae large, distinct, ovate; ocelli moderately large, situated in an equilateral triangle; temples moderate, simple, ecarinate; occipital carina moderate, not terminating below in a spine or tubercle in either sex. Antennae with flagellum of males conspicuously fringed beneath with white hair. Mandibles: in females stout, with apices tridentate; in males more slender, the upper and lower outer margins with a sharp laminate translucent carina between which the surface is flat to very shallowly concave, the apices bidentate; both sexes with a median tooth on inner margins. Females without a psammophore.

Thorax finely punctate throughout. Pronotum short, transverse; rounded and ecarinate dorsally. Mesonotum, scutellum and postscutellum simple; axillae moderate, immarginate. Mesopleura perfulgid, finely punctate; prepectus sharply margined anteriorly; episternal suture more or less strongly foveolate; mesopleural pit distinct; without a tubercle before middle

[18] Polskie Pismo Ent., XII, pp. 254, 256, (1933).

coxae; mesosternum rounded, immarginate anteriorly. Propodeum perfulgid, not coarsely sculptured; dorsal face with a very distinct enclosure defined by foveolate furrow; lateral carinae well defined for entire length.

Fore wings with a more or less distinct fuscous spot in marginal and apex of median cells. Hind wings with anal lobe distinct, large, about two-thirds length of submedian cell.

Legs: in females, fore femora and tibiae inconspicuously subtriquetrous, the fore tarsi not flattened but with an inconspicuous pecten of short, stiff spines, otherwise simple. Males with fore metatarsi strongly and spirally distorted, and hind coxae simple, edentate below.

Abdomen sessile, subfusiform, finely punctate at most; black maculated with yellow. First segment no longer than its apical width, and perfectly sessile with second segment. Females with pygidium strongly narrowed and excavate apically. Males with seventh (ultimate) tergite elongate trigonal, without a pygidium, not appreciably more coarsely punctate than penult tergite, and with flat, inflexed ventral processes which overlie the base of the seventh sternite, the disc of which is keeled, carinate or tuberculate.

Component Species.—At present, the subgenus *Nothocrabro* contains only the North American form *nitidiventris*.

Stictoptila[19] new subgenus

Crabro (13. Group *nitidiventris*) Fox, Trans. Amer. Ent. Soc., XXII, p. 180, (1895); (in part).
Cuphopterus Ashmead, Canad. Entom., XXXI, p. 217, (1899); (in part, not of Morawitz).

GENOTYPE: *Crabro confertus* Fox, 1895 [=*Crossocerus* (*Stictoptila*) *confertus* (Fox)].

The species of *Stictoptila* are superficially much like those of *Nothocrabro*, *Cuphopterus* and *Acanthocrabro*, but the tridentate mandibular apices of both sexes distinguish them from those as well as all other subgenera of *Crossocerus*. The females of *Stictoptila* may be confused with those of *Nothocrabro* but the tuberculate mesopleura of the present group differentiate them from that subgenus.

Diagnostic Features.—Moderate sized, fulgid, finely punctate, black forms well maculated with yellow. Head subquadrate in anterior aspect, broadly subrectangular in dorsal aspect. Front simple, unarmed below; upper horizontal portion bisected by a furrow running forward from median ocellus, and somewhat shallowly concave on each side of this furrow; supra-orbital foveae small, more or less indistinct in males, large and distinct in females; ocelli moderately large, situated in an equilateral triangle; temples moderate, simple, ecarinate; occipital carina moderate, not terminating below in a spine or tubercle in either sex. Antennae with flagellum of males con-

[19] From στικτός, spotted + πτίλα, wings.

spicuously fringed beneath with white hair. Mandibles of both sexes stout, with apices distinctly tridentate; inner margins with a distinct medial tooth; lower margins entire. Females without a psammophore.

Thorax finely punctate throughout. Pronotum short, transverse; rounded and ecarinate dorsally. Mesonotum, scutellum and postscutellum simple; axillae moderate, immarginate. Mesopleura perfulgid, finely punctate; prepectus sharply margined anteriorly; episternal suture more or less strongly foveolate; meospleural pit distinct; with a distinct tubercle before middle coxae; mesosternum rounded, ecarinate anteriorly. Propodeum perfulgid, usually not coarsely sculptured; dorsal face with a very distinct enclosure defined by a foveolate furrow; lateral carinae well developed along posterior faces, often obsolescent along dorsal faces.

Fore wings with a more or less distinct fuscous spot in marginal and apex of median cells. Hind wings with anal lobe distinct, large, about two-thirds the length of submedian cell.

Legs: in females with the fore femora and tibiae subtriquetrous, the tarsi simple and with a weak pecten of a few short, stiff spines, otherwise simple. Males with the fore trochanters, femora and tibiae more or less flattened beneath, the fore tarsi somewhat flattened, the metatarsi more or less spirally distorted; hind coxae simple, edentate below; otherwise simple.

Abdomen sessile, subfusiform, finely punctate at most; black usually maculated with yellow. First segment no longer than its apical width, and perfectly sessile with second segment. Females with pygidium strongly narrowed and excavate apically. Males with seventh (ultimate) tergite elongate trigonal, without a pygidium, no more coarsely punctate than penult tergite, and with flat inflexed ventral processes which overlie the base of the seventh sternite, the disc of which is more or less carinate, keeled or tuberculate.

Component Species.—In addition to *confertus*, this Nearctic complex comprises *ventralis* Fox and *maculipennis* Smith of authors, and also in all probability *canonicola* Viereck and *albertus* Carter.

The nomenclature of some of the species of *Stictoptila* is confused at present. It hinges largely upon the correct identity of *Crabro maculipennis* Smith, 1856. Many investigators erroneously believe Smith proposed *maculipennis* as a new name for *Blepharipus maculatus* Lepeletier & Brullé, 1835, said by these authors to be the *Crabro maculatus* of Fabricius, 1781, but not accepted as such by Smith and later workers. But Smith in 1856 proposed *Crabro pictus* as a new name for *Blepharipus maculatus* Lepeletier & Brullé, 1835 nec *Crabro maculatus* Fabricius, 1781, and described *Crabro maculipennis* as a discrete new form. To further complicate matters, *Crabro pictus* Smith, 1856 is a homonym of *Crabro pictus* Fabricius, 1793. Thus this situation cannot be satisfactorily settled until the types of *Crabro maculatus* Fabricius, 1781, *Crabro maculipennis* Smith, 1856, and the

original material, if it is still in existence, of *Blepharipus maculatus* Lepeletier & Brullé, 1835, are all studied and the results compared.

GENERA INCERTAE SEDIS

The following two entities I cannot place with any degree of certainty. Each may represent some subgeneric category within the genus *Crossocerus*, but whether they are discrete or merely synonyms of some of the preceding subgenera, I cannot say at the present juncture, since I know them only from the unsatisfactory original descriptions.

DOLICHOCRABRO Ashmead

Dolichocrabro Ashmead, Can. Ent., XXXI, p. 216, (1899): (genus only characterized).
Dolichocrabro Ashmead, Proc. Washington Acad. Sci., IV, p. 133, (1902): (*Dolichocrabro wickhami*, first described).

This Alaskan entity may eventually prove to be merely a synonym of *Blepharipus*.

ISCHNOLYNTHUS Holmberg

Ischnolynthus Holmberg, An. Mus. Nac. Buenos Aires, (3), II, p. 472, (1903).
Crossocerus Bréthes, An. Mus. Nac. Buenos Aires, (3), XIII, p. 282, (1911).

I have seen no South American or other material that agrees with Holmberg's description. On the authority of Bréthes, I refer *Ischnolynthus* tentatively to *Crossocerus* (sens. lat.), although I suspect that eventually it will be found to be a member of the *Foxita*[20] rather than of the *Crossocerus* complex.

[20] *Cf.* Pate: The New World Genera and Species of the Foxita Complex. Revista di Entomologia (Rio de Janeiro), XIII, (1942).

Notes on the Genus Bothriocera Burmeister (Homoptera: Cixiidae)

John S. Caldwell

(*Circleville, Ohio*)

The Bothriocera are a homogenous group with definite generic limitations. The color and markings of the species are definite and constant enough to be of value in determination. Dr. Z. P. Metcalf[1] has done much to clarify this group and place it on a workable basis. His key supplemented by illustrations of the male genitalia is excellent and has been a great help to this writer in straightening out this heretofore confused group. Many of the older species are somewhat hazy to the modern worker and will remain so until the types can be examined; however this fact should stop no one from making identifications in this genus as long as the interpretations are firmly established by illustrations of the male genitalia. In this way we may know exactly what the various workers have had before them and this method does not add to the confusion of species. It awaits only the examination of types and at the same time permits progress.

Parvula Fabricius seems to be the only species with a double row of fuscous spots in the apical cells. Metcalf has illustrated his interpretation of *bicornis* Fabr. and Fowler[2] has illustrated his species. *Excelsa* and *venosa* Fowler are very close if not the same. *Albidipennis* Fowler is a freak in that the elytra are folded over one another apically. *Nigra* Fowler is solid black and shiny. I have seen none of these species. All types are in the authors' collection unless otherwise stated in the text.

Bothriocera tinealis Burmeister

Fig. 1

The type locality of this species is the lower Amazon in Brazil and it is improbable that its range extends north into central Mexico. The specimens that I have seen from the States of Chiapas, Oaxaca, and Veracruz in Mexico, and from Guatemala include forms that coincide with the illustrations by Fowler (1904, Pl. 9, figs. 11, 11a). In seventy odd specimens there is considerable variation in color and marking. The light basal spot on the elytra may either be almost absent or enlarged to include the claval area; the subapical area may be almost missing or enlarged to form a broad stripe extending from the sutural margin almost to the costal; the apical area is always clear with clear cut subapical spots present in the cells. The lighter forms appear to have the transparent elytra with a fuscous costal area and two transverse fuscous stripes, one median and the other sub-

[1] Bull. 5 Mus. Comp. Zool. Harvard **52**: 285–289, 1938.

[2] Biologia Centrali-Americana, Homopt. **1**: 82–84, 1904.

apical. In all this variation the male genitalia are constant. The specimens vary in length from 5 mm. to 6 mm. *Tinealis* Fowler is not specific with *tinealis* Metcalf and as suggested by Metcalf is probably not specific with *tinealis* Stal.

Bothriocera westwoodi Stal

Figs. 2, 3, & 3a

In a series of twenty-five specimens from the States of Chiapas, Guerrero, Morelos, and Veracruz in Mexico are a few that coincide with the figure of *westwoodi* Fowler (Pl. 9, fig. 12). There are also extremes in variation in color and marking that might well pass for different species except that the male genitalia is constant. The lighter forms resemble *venosa* Fowler except for the presence of faint submarginal apical spots. In darker examples the submarginal spots have fused together forming an apical band which contains a marginal row of light spots.

In color sequence based on pattern this species forms the link between those species possessing subapical fuscous spots and those that lack such spots.

Another series of specimens determined as *westwoodi* Metcalf because the male genitalia compare well with his figure (Pl. 17) have the basal half of the elytra transparent with the claval area fuscous or semifuscous. The extreme apical area is clear with the line of submarginal spots large but better defined than in *westwoodi* Fowler.

Bothriocera boliviensis n. sp.

Figs. 4 & 4a

Length 4–5.2 mm. Head yellow with central area of frons and clypeus black; margin of frons around antennae black. Pronotum yellowish; mesonotum black. Elytra fuscous with small transparent area basad lying next to claval area and sometimes extended to costal cell; extreme apex of elytra transparent with a row of fuscous submarginal spots large and poorly defined.

The male styles have the outer angles produced into a slender acute tooth. Lateral margins of pygofers somewhat angulate; medio-ventral process short, acute. Aedeagus with two slender apical processes.

Male holotype, female allotype, and eight paratypes from Coroica, Bolivia are in the H. Osborn collection at Columbus, Ohio.

Bothriocera basalis Metcalf

There are two females in this collection that compare well with the illustration of the elytra by Metcalf (Pl. 15), one from San Luis Potosi (DeLong) and one from Oaxaca (Dampf).

BOTHRIOCERA SIGNORETI Stal

Fig. 5

This species was taken in abundance in Oaxaca and Veracruz. Other records include Guerrero, Jalisco, Michoacan, San Luis Potosi, and Sonora.

Bothriocera metcalfi n. sp.

Fig. 6

Length 5.2–5.5 mm. Head and pronotum yellow-brown. Mesonotum fuscous. Elytra fuscous with subbasal yellow spot between claval area and costal area and a transparent postmedian spot with a poorly defined perimeter. The under wings carry the same markings on a fuscous background.

Anal segment of male very elongate, straight, flat apically. Pygofers scarcely produced laterally; medio-ventral process very long, triangular. Styles elongate, arcuate around projection of pygofer. Aedeagus with single slender apical process.

Male holotype Vergel, Chiapas, 5-15-38 and paratype Santa Julia, Chiapas, 3-15-38, (Dampf). Female allotype Orizaba, Veracruz, 10-8-41, (DeLong, Good, Caldwell & Plummer).

The writer takes great pleasure in naming this unique species in honor of Dr. Z. P. Metcalf whose work on the Fulgorina has been an inspiration and a great help.

Bothriocera dampfi n. sp.

Fig. 7

Length 5.5–6.8 mm. Head lighter in color than thorax. Elytra fuscous, pattern similar to *signoreti* Stal except that the basal transparent spot sometimes includes most of the claval area and possibly includes more of the costal area. The extreme apical area is entirely different in that the transparent subbasal spot is very irregular and reaches the apical margin whereas in *signoreti* this spot is evenly lunate and does not reach the apical margin.

Anal segment of male with base and caudal extension about right angled. Pygofers not produced laterad; medio-ventral process very short, rounded. Styles rather long, contiguous for apical half. Aedeagus with two slender apical processes.

Male holotype and paratype from Finca Vergel, Chiapas, 5-13-35, allotype female same locality 5-19-35. Paratype male Vergel, Chiapas, 6-3-35, female paratype Santa Isabel, Chiapas, 9-17-30, and one from Tierra Blanca, Veracruz, 7-29-32, (Dampf).

The writer takes great pleasure in naming this outstanding species in honor of Dr. Alfons Dampf who has initiated the first large scale systematic collection of data on the Insects of Mexico.

Bothriocera transversa n. sp.

Figs. 8 & 8a

Length 5–5.2 mm. Vertex and frons yellow-brown; clypeus broadly yellow on lateral margins. Elytra transparent with fuscous claval area; an irregular fuscous stripe present from stigmal spot to apex of clavus; another irregular but broad stripe present across the apical cross veins; and the apical margin irregularly fuscous. Wings white basad with a postmedian fuscous stripe present followed by a clear area in turn followed by a fuscous band that includes the apex.

Anal segment of male somewhat elongate. Medio-ventral process of pygofers, minute, very slender. Styles broad in either ventral or lateral aspect. Aedeagus rather complicated.

Male holotype, female allotype, and paratypes from Bonefish Key, Florida, 2-22-40, (Caldwell) and one male paratype from Dade Co., Florida, 5-12-39, (D. J. & J. N. Knull).

Bothriocera knulli n. sp.

Fig. 9

Length 5–6 mm. Head and pronotum light yellow. Mesonotum red-brown. Elytra white with claval area very light yellow to fuscous; brown dash present in apex of costal cell and another midway between apex and base; stigmal spot black with a transverse stripe starting from the inner margin thence abruptly moved basad and extended to apex of clavus; radial vein edged with black from stigmal spot to apex where the coloring broadens; cell formed by M1 and M1a(?) fuscous; and the transverse veins broadly fuscous. Markings on female not as sharply defined as on male.

Lateral margins of male pygofers with small projection somewhat ventral; medio-ventral process blunt. Styles short, angled.

Male holotype and paratypes from Gillespia Co., Texas, 6-23-40, female allotype and paratypes from Patagonia Mts., Arizona, 7-20-40, (D. J. & J. N. Knull).

The writer takes great pleasure in naming this beautiful species in honor of both Dr. Dorothy J. Knull and Dr. Josef N. Knull who have collected many new and interesting Homoptera from southern and southwestern United States.

Bothriocera furcata n. sp.

Figs. 10 & 10a

Length 5.2 mm. Vertex, frons, and pronotum yellow-brown. Clypeus yellow, especially laterad. Elytra transparent marked with fuscous; claval area dark; a spot present just caudad basal cell; costal area with a large spot that is clear in the center; a longitudinal stripe present from costal

spot through the transverse median stripe to the subapical band; the transverse median stripe originates at stigmal spot and extends half way across the elytra where it forks with the cephalic branch contacting the claval apex and the caudal branch following the margin and entering the subapical band. Apex of elytra broadly fuscous.

Pygofers of male greatly produced laterad; medio-ventral process short, rounded. Styles acute apically. Aedeagus with a process at the joint.

Male holotype Sanford, Florida, 7-8-31 and female allotype same locality 6-11-31, (at light) are in the H. Osborn collection at Columbus, Ohio.

Bothriocera fasciola n. sp.

Figs. 11 & 11a

Length 4.8–6 mm. Head and pronotum lighter brown than mesonotum. Elytra transparent with claval area brownish; irregular stripe extended from stigmal spot to apex of clavus where it fades out; narrow submarginal band present; all cross veins and forks of longitudinal veins browned. Membrane of elytra and wings minutely roughened.

Pygofers of male with slight projection laterad; medio-ventral process slender, acute. Styles sublanceolate in ventral aspect, sharply angled in lateral aspect.

Holotype male, 6-20-25, from San Pedro Yameri, Oaxaca in Mexico, (Dampf) and female allotype from Puerto Castilla in Honduras, 4-29-26, (H. Osborn collection).

Bothriocera drakei Metcalf

In a series of fifteen specimens of this yellowish form from Florida there is considerable variation in intensity of color. The claval area is sometimes browned but never heavily and the apical band is sometimes nonexistent; however, the male genitalia is constant. The specimens from Ohio[3] identified as *tinealis* evidently belong to this species. The color invades the clavus and the sickle-shaped process arising from the joint of the aedeagus contains one more minute spur, otherwise the two are identical. These differences are scarcely enough to even consider that the Ohio forms are a variety and the series is too short to be certain that these differences are constant.

Bothriocera cognita n. sp.

Fig. 12

Length 5 mm. Head and pronotum smoky yellow; lateral carinae of face yellow. Elytra white with clavus entirely fuscous; and irregular fuscous stripe present from clavus to stigmal area; another fuscous stripe present subapically; apical margin slightly fumed. Under wings fuscous apically.

Anal segment of male short, curved in lateral aspect. Pygofers roundedly

[3] Ohio Biol. Sur. Bull. **35**: 306, 1938.

produced on caudal margins; medio-ventral process small, rounded. Styles very elongate, apices obliquely truncate in lateral aspect. Aedeagus with a small curved process at the joint(?); another stout process present at base of apical flagellate process.

Holotype male from Kosciusko, Mississippi, 6-9-33, collected by D. W. Grimes is in the Ohio State University Collection at Columbus, Ohio. This is probably the same species figured by Dozier[4] as *bicornis* Fabr.

Bothriocera undata Fabricius

Figs. 13 & 13a

The type locality of this species is the West Indies. The only material that I have been able to examine is from Puerto Rico. In general appearance this species can not be separated from *venosa* Fowler, however the male genitalia are distinct. The pygofers extend laterally into blunt obtuse angles; the medio-ventral process is very minute. The styles are evenly arcuate in ventral aspect and appear wider in the apical half in lateral aspect. Whether *undata* occurs in Continental America or *venosa* occurs in Insular America I do not know. It is possible that Fabricius and Fowler had the same species but the chances are very remote.

Bothriocera venosa Fowler

Figs. 14 & 14a

This species is resurrected because the male genitalia are distinct from *undata* Fabricius which it otherwise resembles. The pygofers are broadly rounded laterally; the medio-ventral process is larger. The styles are angulate and widely separated basad in ventral aspect; in lateral aspect the apical half is slender with the extreme apex produced cephalad and caudad. The aedeagus is of a simpler type than that in *undata*. In a series of seventeen specimens from Chiapas, Oaxaca, San Luis Potosi, and Veracruz in Mexico there is some variation. In the lighter forms, similar to the illustration by Fowler (Pl. 9, fig. 14), the claval area may even be clear. The darker examples have the mesonotum and claval area jet black. The median stripe on the elytra may be broad and diffused into the ligher areas. The submarginal stripe may be very distinct and enlarged at the costal margin. Some specimens are exactly like *excelsa* Fowler (Pl. 9, fig. 15) except that the costal cell is not as fuscous as shown in the illustration. I can go no farther than to strongly suspicion that *venosa* and *excelsa* are the same until the types can be examined.

Bothriocera alba n. sp.

Figs. 15 & 15a

Length 5.2 mm. Head and pronotum light yellow except for brown median streak on clypeus and large spot in center of face. Eyes and

[4] Tec. Bull. Miss. Agr. Exp. Sta. **14**: 57, fig. 15, 1926.

EXPLANATION OF PLATE

1. *Tinealis* Burm. Lateral view of abdominal apex of male. 2. *Westwoodi* Stal. (Interpretation by Fowler) Same view as 1. 3. *Westwoodi* Stal. (Interpretation by Metcalf) Same view as 1. 3a. Ventral view of half of abdominal apex. 4. *Boliviensis* n. sp. Same view as 1. 4a. Same view as in 3a. 5. *Signoreti* Stal. Same view as 1. 6. *Metcalfi* n. sp. Same view as 1. 7. *Dampfi.* n. sp. Same view as 1. 8. *Transversa* n. sp. Same view as 1. 8a. Caudal view of male aedeagus. 9. *Knulli* n. sp. Same view as 1. 10. *Furcata* n. sp. Same view as 1. 10a. Same view as 3a. 11. *Fasciola* n. sp. Same view as 1. 11a. Same view as 3a. 12. *Cognita* n. sp. Same view as 1. 13. *Undata* Fabr. Same view as in 1. 13a. Same view as 3a. 14. *Venosa* Fowler. Same view as 1. 14a. Same view as 3a. 15. *Alba* n. sp. Same view as 1. 15a. Same view as 3a. 16. *Maculata* n. sp. Same view as 1.

mesonotum brown. Elytra clear including the claval area; cross veins broadly smoky. Pygofers of male produced laterally, acute; medio-ventral process short, rounded. In ventral aspect, styles broadest at midlength, inner margins concave basad. Anal segment elongate.

Male holotype from Coroico, Bolivia is in the H. Osborn collection at Columbus, Ohio.

Bothriocera maculata n. sp.

Fig. 16

Length 4.7–5.5 mm. Head and pronotum yellow-brown. Mesonotum dark brown between carinae, lateral compartments darker. Elytra transparent, maculate with fuscous; claval area fuscous between claval suture and first vein; a dash present in fork of cubitus; costal area with five large spots between base and apex counting the stigmal spot; cross veins and forks of longitudinal veins smoky; apical area narrowly smoked. The elytra overlay similar to but not as much as in *albidipennis* Fowler. Aedeagus of male with a short notched process at the joint.

Male holotype, female allotype, and paratypes from Dade Co., Florida, 5-12-39, (D. J. & J. N. Knull), paratypes from New Smyrna, Florida, 5-20-43, (Mike Wright). Paratypes present in Ohio State University Collection at Columbus, Ohio.

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* New genera, species, etc. are indicated by italics.

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LLOYDIA

Quarterly Journal of Biological Science

THEODOR JUST, *Editor*
JOHN H. HOSKINS, *Associate Editor*

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